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POWER GENERATION
WATER POWER
DIESEL & GAS ENGINES
AIR CONDITIONING & HEATING
REFRIGERATION
PUMPS & COMPRESSORS
STEAM SERVICES
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NOVEMBER, 1939

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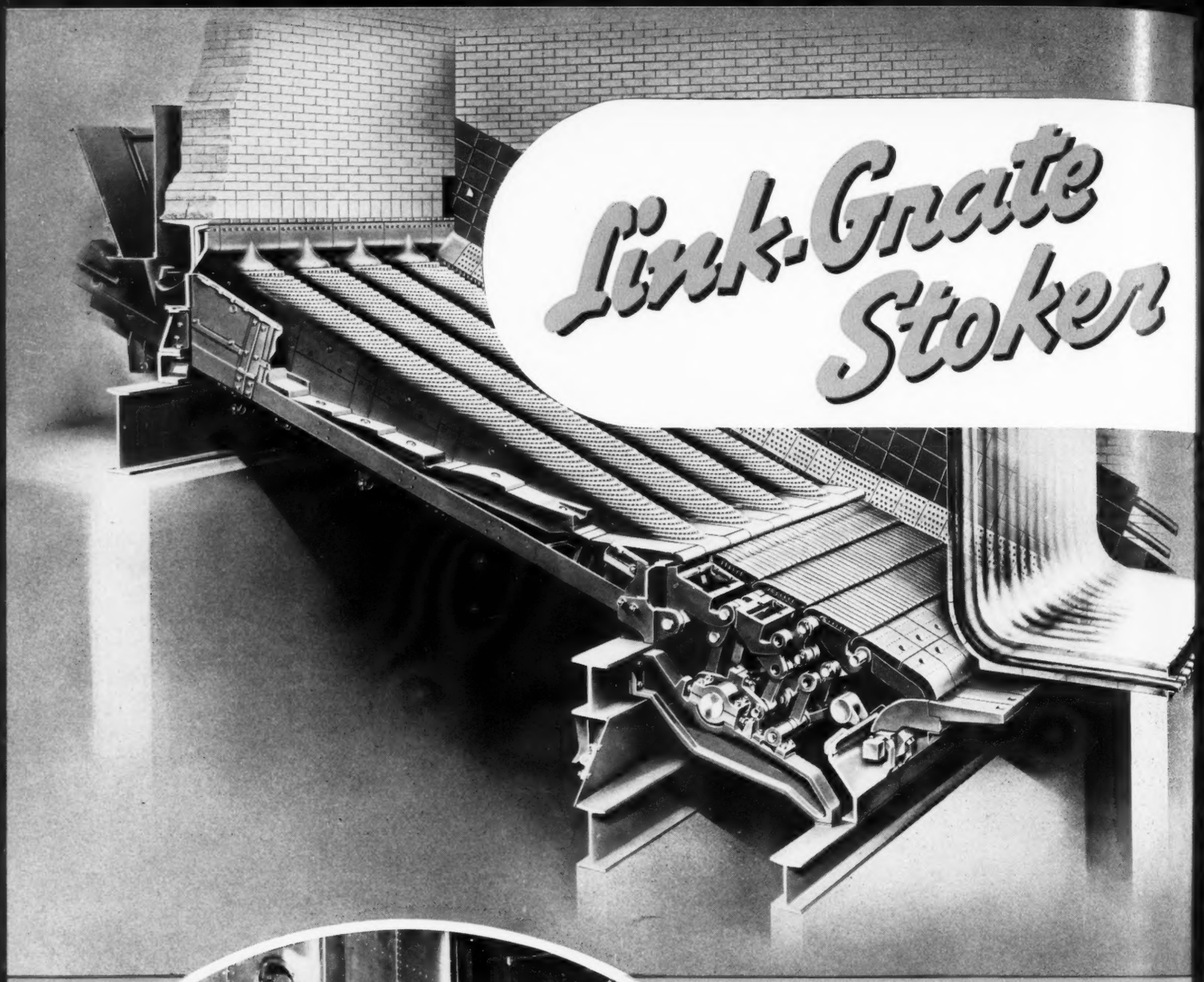
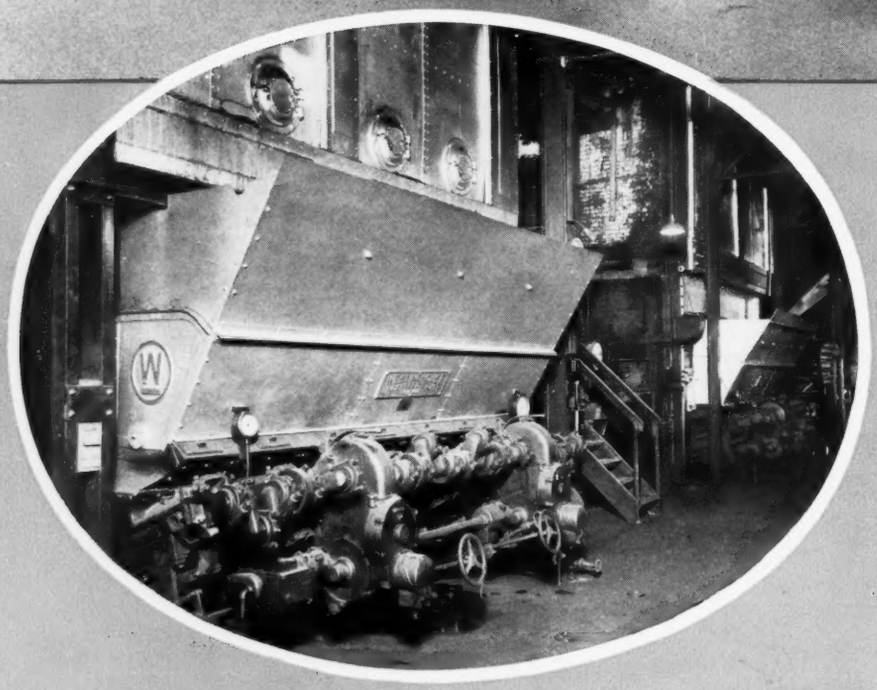




Westinghouse stoker installation at the Howard Paper Co., Urbana, Ohio. Multiple Retort Link-Grate Stokers firing 795 and 816 hp boilers.

Complete Line of Westinghouse Stokers

MULTIPLE RETORT STOKERS FOR BOILERS RATED 300 BHP UP

SINGLE RETORT STOKERS FOR BOILERS RATED 100 TO 500 BHP

Westinghouse

What the War Means to Power Men

By PHILIP W SWAIN, *Editor*
and
S A TUCKER, *Associate Editor*

No one man, single handed, can hope to keep up with the fast-moving events of today, so two of us have signed this article, thereby assuming joint responsibility for a correct statement of today's facts and a reasonably accurate forecast of tomorrow's.

Sources consulted include the entire editorial and business staffs of POWER, the pages of POWER for the full period of the last war, numerous business and technical specialists in the McGraw-Hill organization, trade-association heads, many government officials and independent specialists in Washington, utility and industrial engineers and executives. We have visited such centers as Chicago, Toronto, Cleveland, Pittsburgh, Buffalo, to talk to men in the daily grind of making and selling steel, supplies and machinery.

With this background, we present here what we believe to be an informed appraisal of the situation, particularly as it affects the men responsible for the construction, maintenance and operation of power plants.

In projecting present causes into future effects, we dare not expect 100% accuracy. We do feel, however, that the trends for the remainder of the year are fairly clear and that an intelligent guess running well into 1940 can be made on such matters as fuels and loads.

Please note, however, the two big "if's" on all predictions. First, we have assumed that the present neutrality legislation will be revised to permit "cash and carry" delivery of all types of goods to belligerents. Second, we assume that the war will not come to an early end. If it does, you can toss this article in the wastebasket.

Right here a personal note is in order. Our study indicates that this war (if we stay out) will bring us many of the apparent benefits of a business boom. Please don't assume from this that we think this war is a good thing for America. We don't, not for a minute. In the long run, this country with the rest of the world, will pay for it.

Meanwhile we face the problem of carrying on, since there is apparently nothing sensible America can do to stop the chaos in Europe. From the viewpoints of individual business policy, patriotism, and even international altruism, it seems that we should continue our business and industrial operations along sound traditional lines—expand a little, but not too much, avoid speculative ventures, do our individual best to avoid a runaway price situation, try always to plan well ahead and *keep out of this war*—in short, keep our shirts on!

What Happened to Business? — For years, America had been watching the fantastic course of foreign events. Again and again, world war threatened —and missed by a hair. When, in early September, it didn't miss, the war declaration had already been discounted to a large degree. Business did not slump. There was no panic in securities; in fact the reverse. Stocks shot up and soon steadied at a higher level. A few commodities and raw materials moved up sharply, wavered a little and smoothed out on a higher level. Business assumed a livelier tempo, but didn't go "crazy."

The *Business Week* index of activity, for months steady around 100, rose 18 points in September. Within 30 days after the declaration of war, American business had moved ahead as much as it did in the first 18 months of that other debacle (the war that was to "end all wars and make the world safe for democracy").

Why this sudden business improvement? It cannot be explained by additional war orders pouring in, or the immediate demand of American manufacturers for raw materials with which to fill these orders.

Keep our shirts on!

The answer is clear. Everybody starts to "get ready" for something. Take steel! The railroads see they may

Everybody started to get ready for something

get caught short if freight traffic should boom. They must work months ahead. They start their shops working full speed repairing out-of-order equipment. They ask for thousands of new freight cars.

Next the repair shops and car builders rush orders for steel they must have for their new assignments. The roads also order rails, thousands of tons. As all these lots of steel start moving from the mills, they help create that very increase of carloadings, fear of which caused the steel buying. Meanwhile certain customers outside the railroad circle find they must order more than normal tonnage to meet immediate needs. All this shipment represents actual use.

Immediately, on top of this, comes the speculative buying, orders aimed to get under the wire of present prices and guard against the possibility of delayed deliveries.

Against Runaway Prices—With plenty of time to digest the lessons of the last war, business men approach this one with commendable caution and humility. They do not propose to start any joyride of inflationary "prosperity," to be paid for by the headache of the morning after.

This does not mean that the prices of equipment and supplies will not rise. Primed with more urgent buying, the business balloon must go up, but slowly, well ballasted by powerful influences on the conservative side.

Avoid Overexpansion—Right now a few bearish factors are performing a real public service. One is the repeated warning of business leaders that we must not overexpand. They remember only too well the acres of factory buildings erected at fancy prices to make munitions and other playthings of Mars—plants that were howling successes in 1917 and deserted shells in 1919.

As we see it, farseeing manufacturers will generally aim to handle war business with their present buildings, adding a few machines, doctoring present productive equipment, going to two or three shifts and a longer week, if necessary. Grandiose building schemes will be avoided except where they will pay their full cost in a couple of years.

But Don't Delay Modernization—Yet industrialists must never forget that it is one thing to expand productive capacity on a grand scale and quite another to modernize. The savings of modernization can be realized in good times and bad. The leading manufacturers who now are warning against overexpansion are the very ones, many of them, who modernized their manufacturing and power equipment right through the depression—the ones who were never too poor to make investments that would return 25% or more yearly even at low-level operation.

Incentives to do this modernization job right now—long war or no—are that prices won't soon be lower and may be higher, deliveries won't soon be quicker and may be slower. And if, after the war, prices should return to a lower level, the intervening savings from modernized equipment will offset the difference many times over. Whichever way events turn, the intelligent modernizer cannot lose.

We should make it clear that these comments refer to industrial and institutional plants. As utility engineers

Commendable caution and humility

and executives fully agree, the central-station problem is primarily one of building new capacity to meet growing loads, rather than the modernization of old capacity (except where that also involves increased dependable capacity, as in topping).

Pre-War Babies—Certain war-baby industries felt the effects of the conflict months, and even years, before it actually hit. Outstanding examples are aviation and machine tools. Both were booming long before the crucial week-end in early September.

The machine-tools situation, like steel and the railroads, is of more than academic interest to power men. Delivery dates are moving ahead constantly until now it takes a full year from order until you can get your hands on the goods, on certain machine tools. This affects the power field to the extent that deliveries of certain types of power equipment may eventually be limited by the delivery of new machine tools. Right now, this is not a crucial problem, because power-equipment manufacturers, in general, have enough machine tools to handle expected orders.

Do not hastily interpret this statement to mean that there will be no productive pinch in power equipment. That is a real possibility, particularly in large turbine-generators. More about this later.

Export Trade—Few power engineers have a *direct* interest in foreign trade, but we should mention the matter briefly as part of the general war-business background and also because many of the industrial concerns with which POWER readers are associated will be

Grandiose building schemes will be avoided

getting war orders from abroad, or be looking for them.

In such cases, the engineer, without professing any special knowledge of foreign trade, may relay a useful tip that comes to us from men long experienced in this field: "Watch your step or you'll lose your shirt."

Government Control—Like every other rose, war business has its thorn—a weedlike growth of government control, mighty hard to clean up after the war is over. In times of peace, business in democratic countries, operates mainly through private initiative. War brings many abrupt changes in balance and direction. If adjustments are not made rapidly enough under democratic procedures, the pressure to strong-arm one area of economic life after another becomes almost irresistible. Thus do we get fuel administrators, railroad czars, and maybe power potentates.

The trouble is that such controls, instituted for reasons of real or imagined necessity, tend to hang on leech-like after the war that spawned them; it's always hard to dislodge any bureaucracy after it has once tasted its powers and its steady jobs.

Even where government operation is given up, the "evil that men do lives after them." Witness the American railroads, even today doing penance for the precedents set under war-time

government ownership and operation.

For many good reasons Americans want to stay out of this war. One of the best is the well-grounded fear that it would set up dictatorial controls which would tie our whole economic life in knots for decades to come.

Right now, when we are definitely figuring on *not* getting our fingers burned in the present European flare-up, interstate natural-gas lines have been put under government control. Petroleum (from well to service station) is threatened. Bituminous coal operates under a price-limiting law and some in Washington have their eyes on the electric utilities.

Aside from pointing out the dangers of centralized control, and staying out of active participation in the war, the

Watch your step on foreign business

best way to avoid these evils is to demonstrate the ability of private operators to handle any situation that may arise.

No Power Shortage — The electric utilities all over the country have been studying their capacity and surveying load growth, particularly as it might be affected by a long conflict. They find, and our own studies support no contrary conclusion, that any widespread shortage of central-station supply this winter is extremely unlikely. The outlook for the winters of 1940-41 and 1941-42 seems to us more uncertain. Yet even here it appears that ample new capacity will be installed in time, provided there is no serious jam in the production and erection of large power units, particularly turbine-generators—most obvious bottle neck in the supply—and skilled labor, as important as any factor in meeting initial operating date.

However, we hasten to point out that no power shortage right now does not mean no power equipment is being sold. At time of writing we know of orders for some 350,000 kw announced by utilities since the war began. These are solely utility, probably not complete, and include no industrial purchases. Although no figures are available, turbine manufacturers report that industrials are even more active.

As an example of how public utilities are looking ahead, there is Public Service Co of New Jersey, with a 1938 peak of 623,000 kw. To supply this there are 737,000 installed kw—spare capacity of 115,000 kw, or 15.6%. But their program of future development calls for completion of a 100,000-kw turbine-generator at Burlington next summer and an order has just been placed for a 50,000-kw unit for Marion.

This case is typical. Wisconsin Electric has ordered a 35,000-kw unit for Commerce St Station, Milwaukee. Providence has bought a 40,000-kw machine for Manchester St Station, Philadelphia Electric a 50,000-kw turbine for Chester Station, Commonwealth & Southern two 35,000's for Macon, Ga., and Mobile, Ala., Safe Harbor a 25,000-kw hydro, and many more are on the fire.

Big-Turbine Bottle Neck —As things stood early in October, deliveries on large turbine-generators (40,000 kw and up) were running 11 to 14 months. Thus a unit ordered in October, 1939, might conceivably get running in time for the winter peak of December, 1940. It appears that most of the units needed have already been ordered and will be installed in time.

Government control grows

A very few more orders will fill the large turbine shops "choc-a-block" and then deliveries will lengthen rapidly to 18, 20 and perhaps even 24 months. If, then, hostilities drag on, and we have a real "war boom," the critical time in utility capacity may be the winter of 1941-42.

Only three U. S. firms are equipped to build large turbines. Their capacity is definitely limited by that of certain machine tools in their production lines, by their floor area and by the number of experienced mechanics available for certain delicate operations. It seems utterly impossible to train new skilled men for some of these operations on short notice.

Industrial Power Problems—The situation as far as smaller power equipment is concerned is entirely different. Here the builder can expand operations considerably, although rising volume will almost certainly mean increased

Takes longer to train a mechanic than a soldier

prices and some lengthening of deliveries. A checkup made shortly before going to press reveals the beginning of a real sales boom in many lines of industrial power equipment. The number of inquiries now in hand for boilers and turbines leads to the expectation of a busy winter for manufacturers of all lines of industrial equipment and supplies.

Quite a few industrial plants have already gone to two- and even three-shift operation. This leaves little time to patch up obsolete industrial-power equipment (cleaning boilers, repairing brickwork, etc). If we see a trend to 6- or 7-day schedules, some plants will face the necessity of having at least one spare boiler and one spare generating unit (preferably two of each) to take care of routine maintenance plus accidental shutdown.

In checking their ability to get quick delivery on needed units, power men must not merely consider the productive capacity of the equipment manufacturer, but also his ability, in turn, to get needed steel products such as sheet, tubes, and piping.

Skilled Labor Shortage — One more bottle neck (and this may be the most serious strictly industrial problem facing America today) is an impending shortage of skilled labor. Unemployment figures don't tell the story, because few of today's unemployed are skilled.

It takes longer to train a mechanic than a soldier. To make matters worse, the unions discouraged apprentice training during the depression when it was so hard to place their own members. To meet this shortage, we shall need highly organized training courses, plus (in some cases) work teams for certain kinds of jobs—say two men to swing hammers with one man telling them where to hit.

The Future —This is our best estimate of the situation as we see it today and the immediate tomorrow. Knowing that we cannot be 100% right in all details, we shall watch the trend of events closely and report again to POWER readers.

Fuels and Transportation—Are They Bottlenecks?

By PAUL WOOTON, *Washington Correspondent*

AMERICAN CAPACITY to produce is such that coal and petroleum can be made available more rapidly than industry can use them up. With coal, the limiting factor is transportation; with oil, new Houdry cracking units going in will lower the amount of Bunker C going to market.

Watch Fuel Transportation—Every one in the coal industry and every coal buyer knows that the shortage in 1917–18 was caused by inability of the railroads to handle distribution. Today, there is considerable difference of opinion as to how well they will stand up this time.

The American Association of Railroads issued the reassuring statement that they can take care of a 25% increase in freight traffic, as is, and 50% with overhauling of present out-of-order equipment. However, some very close observers of railroad matters disagree. In particular, they say the 50% is nonsense. No matter who is right in this debate, the railroads are moving at top speed to build freight-handling capacity.

Railroads are moving at top speed to build capacity

In the first eight months of 1939, car loadings grew slowly from 580,850 to 688,591 per week. Then the week ending Sept 16 jumped 20.7% over the preceding week. In October, loadings passed the 1937 peak of 847,000. Net operating income of Class I carriers jumped from $500,000,000 to over $600,000,000, putting them in the black and allowing them to place "hurry" orders. On October 6, for example, the Santa Fe announced expenditures of $21,000,000 for 2800 new cars, rebuilding of 2500 others, and new trackage. Also, on the same day, the Chicago, Rock Island and Pacific received court authority to repair 400 cars, purchase 1000 new lightweight steel box cars, and buy 20 switching locomotives.

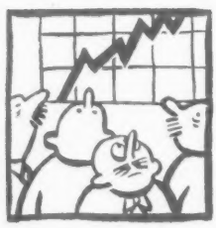
No Lack of Coal-Mine Capacity—At the moment, capacity of coal mines in operation is less than in 1937, but this could be stepped up quickly to the 1937 level. Production has been running about 9,000,000 tons per week, with miners on a short week. Without additional mines or labor, this could easily be pushed up to 11,000,000 and probably to 14,000,000 with a long week and overtime.

In 1938, 342,000,000 tons were mined. Due to the war and speeding up of American industry, this year may run as high as 400,000,000 tons. In the peak year of the last war, 597,000,000 tons were burned, topping even the mark of 535,000,000 tons of bituminous coal (including overseas exports) set in the bustling year 1929. In 1937, the most active industrial year since then, the demand was only 442,000,000 tons. It is hard to conceive of difficulty in mining any amount that might be required.

How About Oil?—More uncertainties apparently surround the future price and supply of Bunker C than coal. Fuel oil had its bad jams in the last war, but stationary plants (then predominantly coal-burning) were affected only here and there.

With the data on hand, it is difficult to say whether a prolonged war would endanger the supply of fuel oil to stationary plants. Refinery capacity, rail-handling ability and pipe-line mileage are all important parts of the picture. Also, oil in all its forms is a deluxe fuel. Certainly, military and naval uses would have first call on petroleum products, with other users taking the leavings.

As far as price goes, Bunker C (about the only petroleum product used as boiler fuel) should go up more than coal. Remember it is definitely a by-product—crude is produced and refined to meet the gasoline market. Bunker C is merely what's left over, to be sold for what they can get for it. Its price is determined by supply and demand, rather than by production cost. Also, the number of oil-burning plants has grown recently and there may be a big demand for naval use here and abroad.



Watch oil price trends

Then there is the new Houdry cracking process which puts out only gasoline and household furnace oil (or diesel oil), leaving no Bunker C. By next spring, with six or more of the projected Houdry units in operation, about 10% of the nation's crude will produce no Bunker C whatever.

Hence, it is expected that price of Bunker C will rise more than that of coal. Many border-line plants may find it worthwhile (or necessary) to shift back from oil to coal. It should pay to keep a close watch on oil-price trends and on means of shifting to coal firing, if, when and where necessary.

POWER

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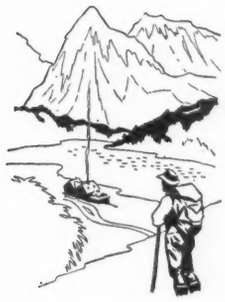


Western Empire

Fiction has it that man has conquered the Rocky Mountains six times — by trail, rail, wire, motor highway, airplane and radio. Yet the economic fact is that the Rockies have never been conquered; they have merely been mitigated. Miles and mountains still mean money.

True, you can dramatize man's conquest of nature by flying an actor from New York to San Francisco, or an orchid from Los Angeles to Boston — if cost isn't important. But less precious freight must go by rail, or by ship through the Canal. Even with the cheapest available transportation, the miles pile up costs for any product whose value is only a few cents, or a few mills, per pound.

That is why the west coast is a sort of separate empire, shipping East the concentrated values of its opulent soil, seas and mines — its best fruit, canned salmon, timber concentrates in the form of pulp and finished lumber, petroleum products, gold, silver and other valuable minerals. Not many fabricated metal products flow East, unless they be of high value per pound, or easily transported — airplanes, for example.

To balance this commerce, the East sends West those complex products of mass production whose starting point must be close to iron, coal and the center of a vast consuming population. It costs nearly $200 to set a Detroit car down in Los Angeles or San Francisco, but that is less than the waste through small-scale automobile production on the Coast, plus freight on materials and manufacturing equipment.

When all is said and done, the West must continue largely as a separate empire, trading with the East as with a foreign country, though fortunately without barriers of prejudice, language, or tariff. In the long run, this may prove a national advantage, rather than the reverse. Being a relatively new and different country, the West is meeting its unfolding problems with a new and improved technique.

To get down to our own knitting, let's consider power technique. Blessed with a wealth of gas, oil and wood, the West has forged ahead in the knowledge of burning these fuels. It has learned how best to pump water from wet places to dry. From all this experience, improved methods are beginning to flow back toward the rising sun.

In this export and import of money-saving ideas, the technical magazine is a common carrier that hurdles distances and mountains with no problem of tonnage. Reduced to print, a thousand-dollar idea weighs but a fraction of an ounce. Its shipment, as part of a bundle of such ideas, is no problem.

Sensing the need for still better teamwork between the engineers of West and East, POWER has recently strengthened its editorial contacts all the way from Denver to Los Angeles and up the coast to Vancouver. From these, a wealth of "know how" is already moving eastward.

All of which is a new orientation of POWER's perpetual job — bringing good ideas, wherever developed, to readers wherever they may be.

Form-Fitted Power Plant

Object achieved by Utica Knitting Co is making plant exactly suit needs for steam and power. It now supplies neighbor with steam, buys some power, puts most all Btu's to work

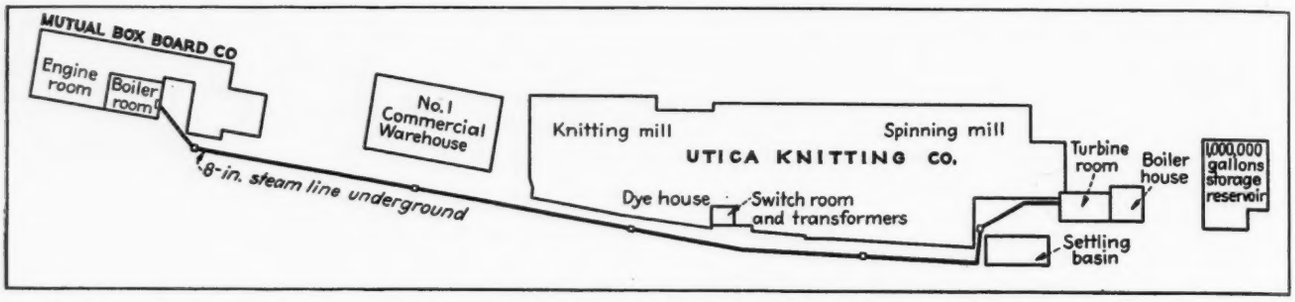


Fig. 1—Plan shows how plant serves knitting and board mills. Water reservoir serves as cooling pond and process-water supply

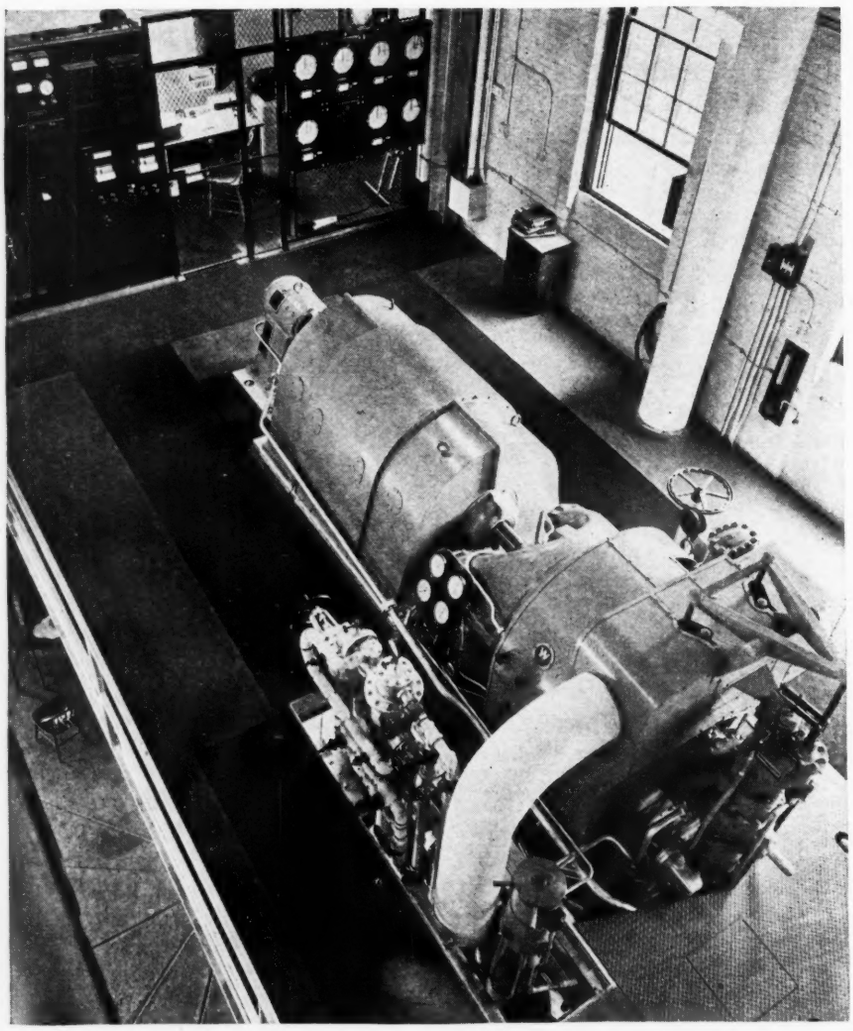


Fig. 2—Automatic-extraction, 3600-rpm turbine-generator, nominally 1000 kw, takes all plant load up to its capacity, corrects power factor of purchased power

A NEW TURBINE, a thoroughly modernized boiler house and an underground steam line consolidate in one location the power and steam-generating facilities of the Utica Knitting Co (Utica, N. Y.) and the Mutual Box Board Co, an affiliated concern. Requirements were not only to generate as much byproduct power as possible from existing process-steam needs, but to supply some additional condensing power, operate in parallel with utility supply and correct power factor so that purchased energy might be had under favorable terms.

Original Plant

Original facilities, known as the Erie St plant, consisted of two 4710-sq-ft vertical 2-drum boilers, set in battery, fired by overfeed stokers with pneumatic supplement. They were equipped with cast-iron economizer and induced-draft fan. Coal and ashes were handled manually, firing conditions were unsatisfactory and steaming capacity limited; low efficiency and high labor account added to the incentive to modernize the plant.

Several other factors also affected the plans. Zeolite-softened water, stored in a large steel tank, supplied both process and boiler feed but temperature varied from 60 to 200 F. Severe carryover and oxygen corrosion hampered operation. Also the boiler plant of the Mutual Box Board Co, immediately adjacent, was about to suffer a serious reduction in pressure due to age and condition.

Advantageous purchased-power rates, which had been available for some time, were withdrawn in 1937 and new rates established carrying higher demand charge and full power-factor penalty.

The program authorized to improve steam-generating facilities included centralizing all power and steam operations in one plant, transporting steam to the board mill in an underground line. As process steam was sufficient to generate most of the power required, a turbine-generator set of moderate size to operate in parallel with the utility connection was indicated. However, no spare steam- or power-generating units were installed as operations could be temporarily transferred to other plants in event of interruption of service.

In revamping the boiler plant, new single-retort side-dump underfeed stokers with forced-draft fans and plenum chambers were installed. The furnaces were rebuilt, using special carborundum blocks at the stoker level for admission of secondary air over the fire, and original tile baffles were replaced with monolithic construction. To improve the carry-over condition, separators were placed in the steam drums, a continuous blow-down system installed and water level controlled by automatic feedwater regulators. Combustion was controlled by a simple system maintaining suitable furnace draft and constant steam pressure.

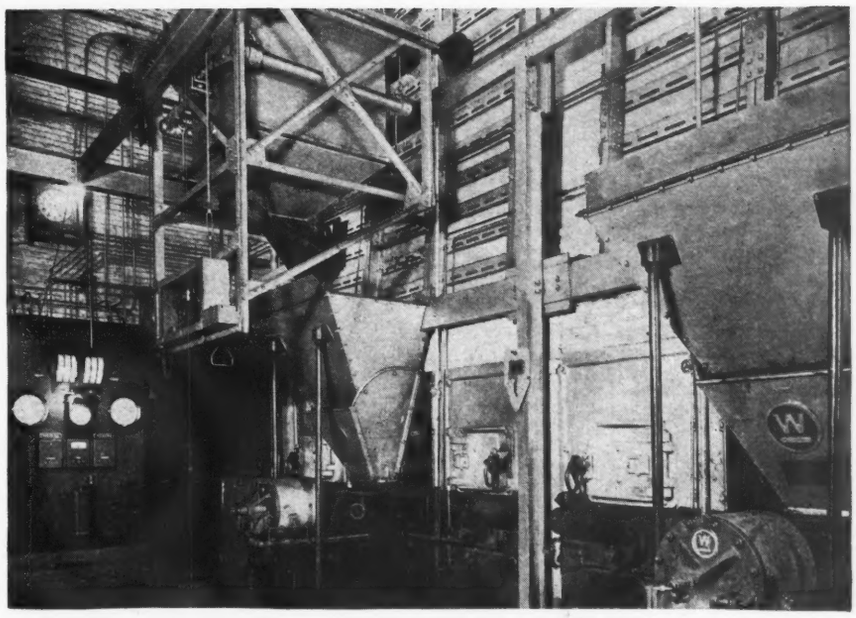


Fig. 3—New stokers, fans, steam separators, blowdown system, coal conveyors and larry give new lease of life to old boiler plant, make it do the work of two

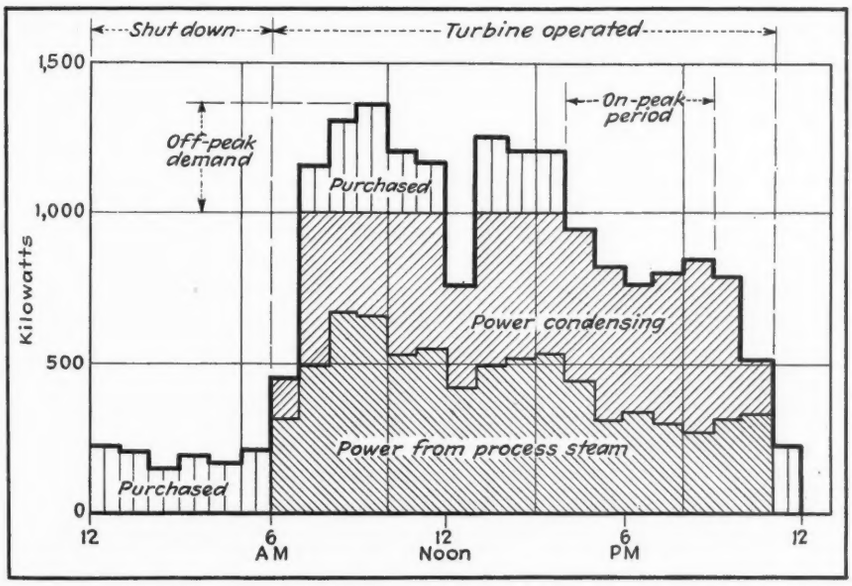


Fig. 4—Typical load curve illustrates how best use of byproduct, condensing and purchased power is accomplished without taking power from the utility during on-peak period. Turbine is normally off the line at night and over week ends

Coal-handling facilities consist of a new track hopper, Redler conveyor and elevator to a 110-ton cylindrical steel bunker and a 1-ton larry for weighing and transport to the stoker hoppers. The conveyor can also take coal from the storage piles to the bunker. An 8-in. steam-ejector conveyor takes ashes from in front of the stokers to a hopper outside the boiler house.

To separate process and boiler water completely, a 10,000-gal. cypress tank stores process water preheated in a condensing heater under temperature and level control. This hot-water system also levels out previously experienced violent steam demands from dyeing operations.

A reducing valve and regulator from the 15-lb header maintains pressure in the completely repiped 2-lb exhaust lines and insures proper functioning of the original deaerating heater. High alkalinity of the boiler water is reduced by mixing raw with softened water and supplementing with an internal treatment. Operating pressure was increased from 135 to over 200 lb for power generation and transport purposes. However, installation of superheaters was not feasible physically or from an operating standpoint.

Welded Steam Line

A 1500-ft underground line delivers steam to the board mill. The 8-in. line, welded throughout, is insulated by glass wool in a 15-in. 2-section circular tile conduit supported by a tile drain section on a concrete base. Internally-externally guided expansion joints are in concrete manholes at suitable intervals. The line grades uniformly for its entire length, moisture being removed by a steam separator and traps at the board-mill end where dry steam is delivered through a reducing valve and regulator at 125-lb pressure.

For power generation, the turbine operates in parallel with the utility, advantageous from an over-all cost standpoint and for operating convenience. This eliminates operation and attendance for light loads, provides two sources of supply for essential services and requires very little additional steam from the boilers during their peak period. Designed for automatic extraction at 15-lb to process and heating lines and condensing to 28-in. vacuum, the turbine avoids heavy demand charges during the on-peak period when power available from process steam is relatively small. The 3600-rpm impulse turbine has a 2-row Curtis stage ahead

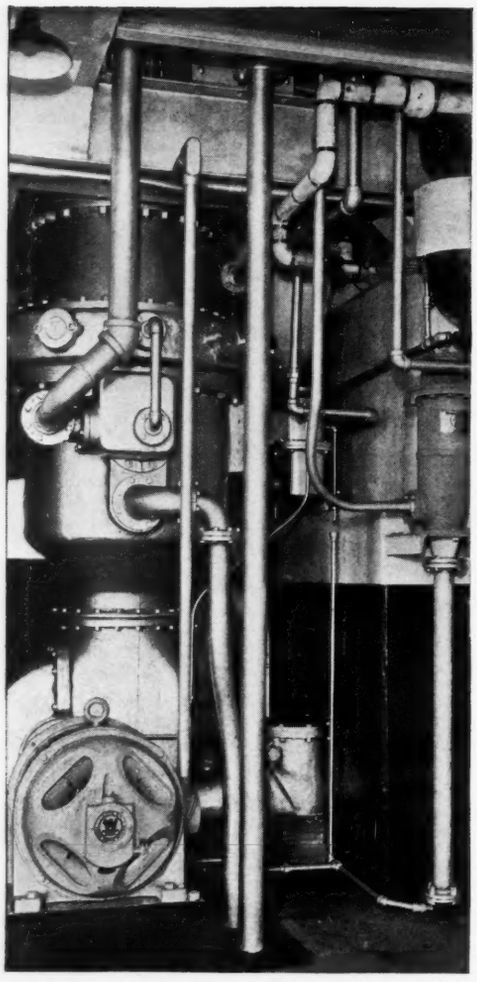


Fig. 5—Steam to condenser is only 15% of total feedwater to boilers, so low-cost jet condenser warms process-water supply in reservoir

of the extraction point and five Rateau stages between extraction point and exhaust.

A feature is the use of load control when operating in parallel with the utility so that the unit takes all plant load up to its capacity, nominally 1000 kw. Power is taken from the utility to supply the remaining load. A directional regulator element actuates a motor to control the governor relay operating the steam chest valves. This mechanism maintains zero power flow from the utility up to the capacity of the unit.

Power-Factor Control

Pressure in the 15-lb line is maintained by operation of the extraction grid valve through a relay with compensation in the position of the steam-chest valves. The 1562-kva, 2400-volt, 3-phase, 60-cycle generator is equipped with a direct-connected exciter and air cooler. Power-factor control is also used for parallel operation so that the oversize generator takes all of the reactive component of the plant load and power taken from the utility line is at unity power factor. An element similar to the load-control unit in the incoming line actuates a motor-driven rheostat controlling excitation to maintain zero reactive in the incoming line. Limit devices are used in conjunction with the load and power-factor controls to prevent operation of the generator beyond its design capacity.

Normally, the unit takes all plant load during the on-peak period from 4 to 9 p.m., Fig. 4. An off-peak demand of 200–400 kw in the utility is set up on the 10-a.m. and 3-p.m. peaks of the plant load. Provision is also made for disconnecting the utility and operating the unit by itself to carry the entire plant load at times of relatively low mill production. The arrangement is convenient, since when load is insufficient to justify operation and attendance, the turbine may be shut down and energy taken from the utility without exceeding the established off-peak demand. Steam to the 15-lb process line is supplied through a reducing valve when the turbine is off the line.

Jet Condenser

As the amount of steam condensed is only 15% of total make-up to the boilers, a low-level jet condenser was selected, this type being lower in first cost, simpler to operate and easier to maintain. An existing concrete reservoir of 1,000,000-gal. capacity is zoned so that circulating water comes from the area of cold supply and is discharged at the process-water intake, which entirely absorbs the heat from the condensed steam in usable form except when the largest water consumer, the board mill, is shut down. At such times it is necessary to waste some water to maintain suitable vacuum. Thus, practically all power generated is a byproduct of process and heating requirements of the two industries. Since

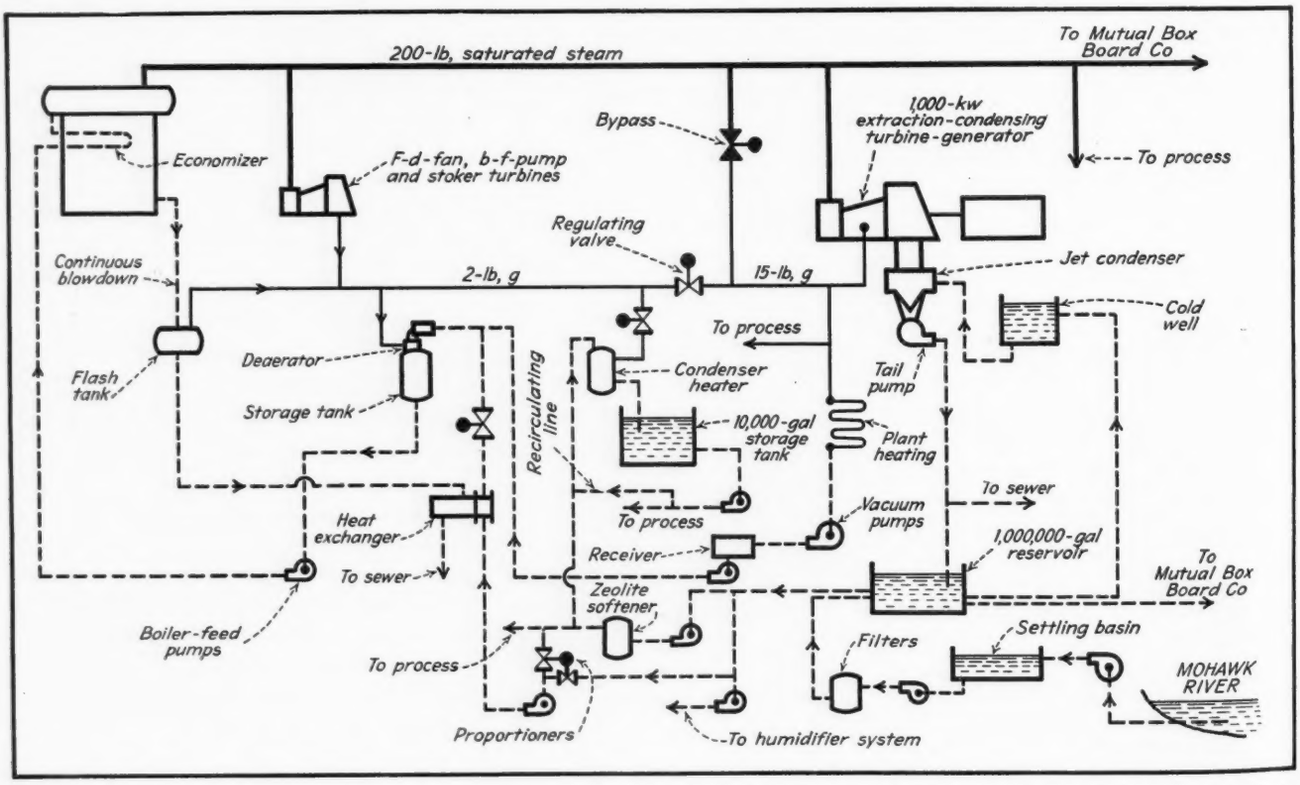


Fig. 6—Flow diagram shows how process water, important item in textile mill, is worked into plant heat balance to board Btu's

Principal New Equipment—Utica Knitting Co

GIBBS & HILL, INC—Consulting Engineers

Steam Plant:

Stokers, 2 single-retort side-dump.....Westinghouse Elec & Mfg Co
98.1 sq ft grate area, 9 ft 1½ in. length
Fans, 2—16,000-cfm, 4-in. w g turbo-blowers.....L J Wing Mfg Co
Carborundum brick linings...Drake Non-Clinkering Furnace Block Co
Furnace front walls.....Bigelow-Liptak Corp
Baffles.....Plibrico Jointless Firebrick Co
Steam separators, Tracyfiers.....Blaw Knox Co
Feedwater and excess-pressure regulators.....Swartwout Co
Coal-handling equipment.....Stephens Adamson Co
Steam flowmeters.....Republic Flow Meters Co
Reducing valves and regulators.....Ruggles Klingemann Co

Power Plant:

Turbine-generator, one 1000 kw.....Westinghouse Elec & Mfg Co
3600 rpm. Automatic extraction at 15 lb, condensing. Generator, 1562-kva, 2400-volts, 3-phase, 60-cycles, 60 deg C. 18-kw, 125-volt, direct-connected exciter
Condenser, low-level jet.....Westinghouse Elec & Mfg Co
With removal pump, 2-stage steam-jet air ejector with jet-type inter and after cooler, 28-in. vacuum, 1950 gpm, 80 F
Generator air cooler, 405 sq ft.....Westinghouse Elec & Mfg Co
Switchgear and board.....Westinghouse Elec & Mfg Co
Power factor and load controls
Transformers, 2400-480 volts.....Westinghouse Elec & Mfg Co
2 750-kva Scott-connected, 2 75- and 3 25-kva, 3-phase, 60-cycles
Motors and starting equipment.....Westinghouse Elec & Mfg Co
Piping.....{Lincoln Supply Co / Grinnell Co}
Pipe insulation.....Johns-Manville Corp
Transite circulating-water pipe, 12-in.....Johns-Manville Corp

Steam Line:

8-in. internally-externally guided.....American District Steam Co
Expansion joints; 15-in. tile conduit, drain and supports; glass-wool insulation, anchors
Piping.....Crane Co

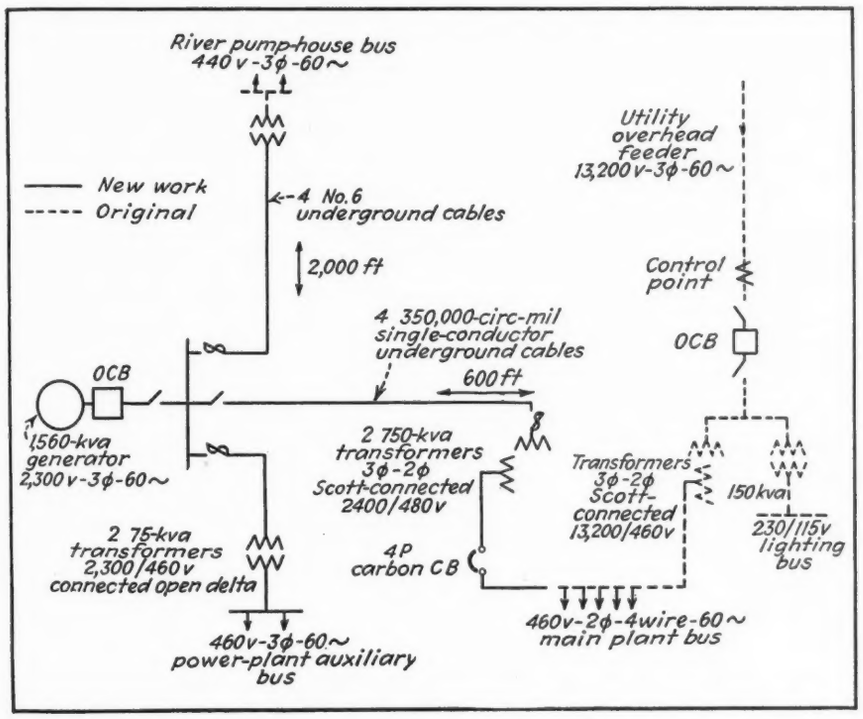


Fig. 7—Electrical installation connects plant and utility feeder, to supply 2-phase and 3-phase loads, lighting and auxiliaries from either or both sources

the level of the reservoir varies considerably, circulating water flows by gravity into a cold well under float control and from which water is drawn into the condenser under a fixed head eliminating variations in flow and vacuum. Circulating water is conveyed to and from the reservoir underground in 12-in. Transite pipe.

Electrical System

The electrical connections, Fig. 7, were complicated by the need for plant service distribution at 440-volts, 2-phase, 4-wire, 60-cycles at a point 600 ft from the turbine room and use of power at 440-volts, 3-phase, 60-cycles at the river pumps, 2000 ft away. Generation at 2300-volts, 3-phase, 60-cycles was selected because of the distance involved and to permit economical transmission in any future expansion. Power is transmitted in trench-lay cables to the main plant distribution center through two Scott-connected transformers and a carbon-type circuit breaker.

New power-plant auxiliary motors were installed at 440-volts, 3-phase, 60-cycles and are supplied through a bank of two single-phase transformers connected open delta, which could be expanded to meet future requirements by addition of another unit. Fuses for 2300 volts are boric-acid type. Combination linestarter and Deion breakers were used in connection with the 440-volt auxiliary motors and in electrifying certain drives at the board mill.

Operation of the improved facilities has materially reduced steam and power costs. Burning less expensive coals, evaporation now averages 10.5 lb of steam per pound of coal as compared with a previous average for the two plants of about 8 lb. Steaming capacity of the boilers has been increased by 30% or more.

A smaller operating force is now employed for production of steam for both mills and power for the knitting mill than used to be employed for steam production only for the Utica Knitting Co. The generating unit has not been operating long enough to make seasoned data available, but operating experience with the new equipment is satisfactory and indications are that anticipated results will be realized.

No attempt has been made to construct the most modern and efficient plant possible; rather, advantage has been taken of every existing circumstance to fit the plant to the exact needs of both mills. Thus, a serviceable supply of power and steam is had at moderate cost.

Engineering and design were by Gibbs & Hill, Inc, in cooperation with Mr Hugh S Jones, plant engineer of the Utica Knitting Co, who also supervised the construction work.

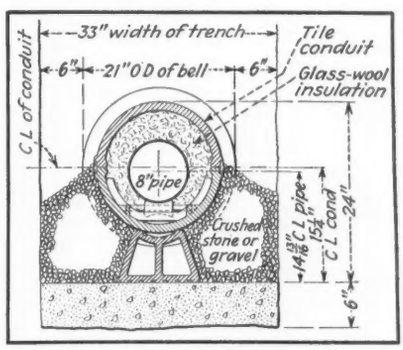


Fig. 8—Cross-section shows construction of 1500-ft underground steam line insulated with glass wool

Why Not Condition with Ammonia?

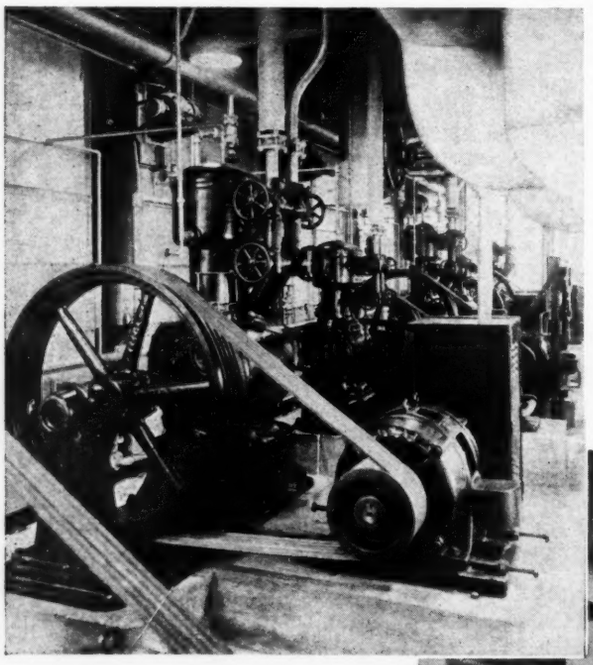
By R SIMS MUNFORD
Frick Company

Time-tested refrigerant cuts investment and operating costs. Outstanding installations show how designers cash in on ammonia's advantages, overcome its disadvantages

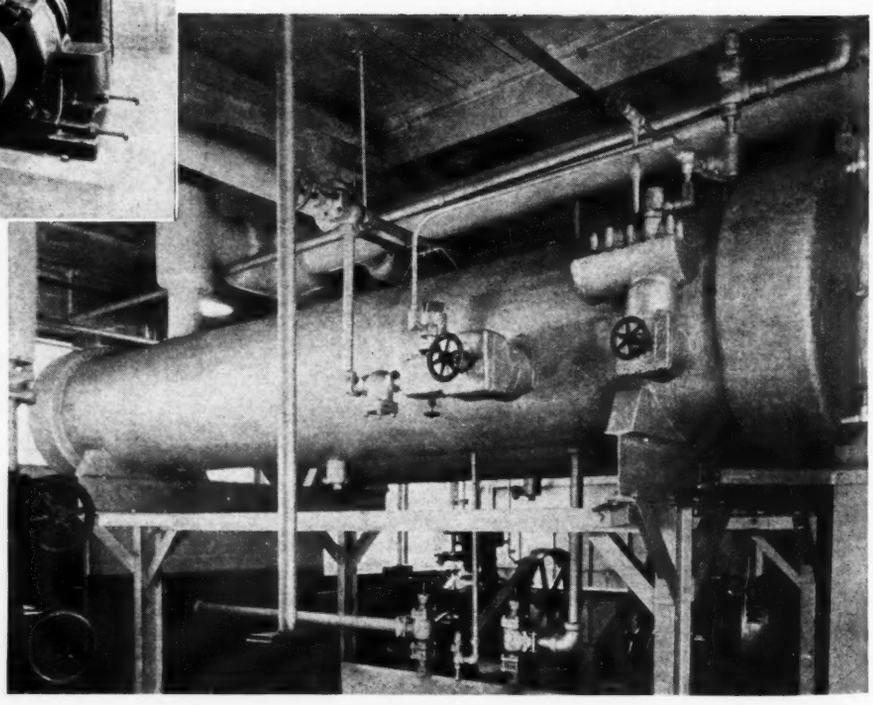
THE SPECIFICATIONS for an air-conditioning system, as written today, generally call for a refrigerant that is non-toxic, non-irritant, and non-flammable. Ammonia, while not poisonous, has a strong irritating effect and under certain special conditions will burn and even support its own combustion. Chiefly for these reasons, ammonia, the old reliable upon which the present refrigeration industry was built, is too often eliminated from the air-conditioning field. This article aims to show the definite advantages of ammonia for certain types of installations, and, by using successful installations as illustrations, to show that this refrigerant, while much abused, has not been discarded for air-conditioning work.

Recently developed low-pressure refrigerants meet a real need in the small air-conditioning system, as well as in many larger plants where a strictly non-toxic refrigerant is required. Of course, it is not advisable to use ammonia in unit air conditioners or in any system that has direct-expansion coils in the air stream. Such applications of ammonia, as well as hazardous applications of other refrigerants, are limited by the various safety codes. Larger manufacturers of refrigerating equipment construct machinery for either ammonia or low-pressure refrigerants and can supply whatever type meets the requirements of a particular job.

Whatever the refrigerant used, most large systems have the refrigerating equipment in the basement, sufficiently isolated from the remainder of the



Penthouse on roof of Sattler's department store (Buffalo) houses eight ammonia compressors and eight evaporative condensers, plus water coolers (not shown)



One of three shell-and-tube water coolers at Sattler's

building so that ammonia, in an indirect system, might be economically employed.

The chief advantages of ammonia are economic and thus its wider use might well offset the big obstacle in the development of air conditioning—its high cost. There are two parts to the cost question: installation and operation. Use of ammonia reduces both. As a general comparison, in large plants, an ammonia system costs from 5 to 10% less to install than a low-pressure-refrigerant system, and shows savings of from 20 to 25% in power bills. The latter does not include additional savings in maintenance, resulting chiefly from less replacement of refrigerant and oil.

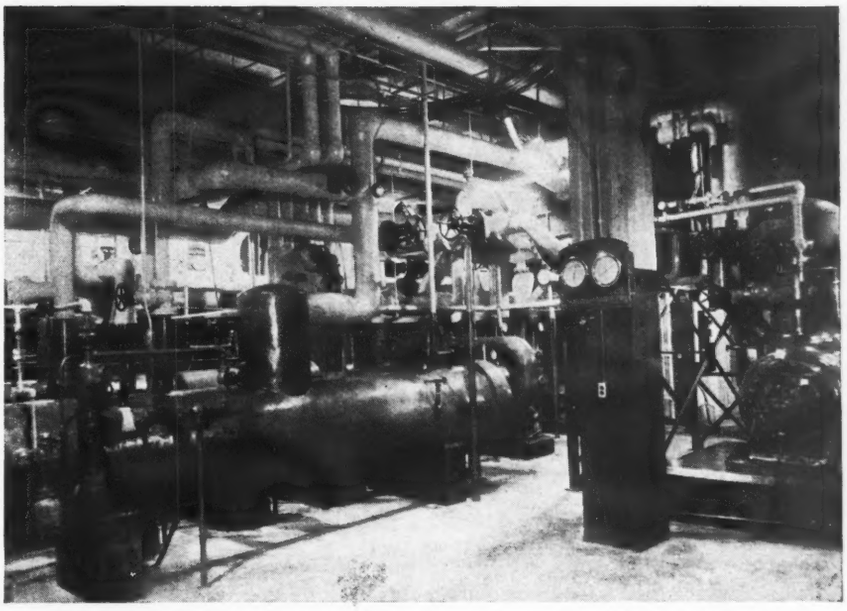
The reasons for these savings are inherent in the characteristics of ammonia as a refrigerant. Ammonia installations cost less, because its high refrigerating effect per lb means low piston displacement per ton of refrigeration produced and consequently a relatively small compressor. Vapor density of ammonia is such that high velocities through suction and discharge piping are permissible, reducing size of pipe required. Slightly higher head pressure than for low-pressure refrigerants does not offset to any great extent gains in installation cost resulting from these properties.

Principal Gains

If theoretical hp per ton is considered alone, it is hard to see how use of ammonia can reduce power bills drastically. Principal gain is a practical one—friction losses in valve ports and piping are extremely low with ammonia, saving compressor power. Maintenance savings depend principally on ammonia's cheapness (only water and CO_2 cost less) and its lack of high miscibility with oil.

Most of the larger office buildings, hotels and hospitals have had ammonia systems in service for years, chilling drinking water, making ice, and cooling refrigerator boxes by the dozen. The irony of the situation lies in the fact that in many cases new air-conditioning equipment, using low-pressure refrigerants, is being placed in the same engine room, side-by-side with time-tested ammonia compressors and equipment.

These older ammonia systems have operated successfully for a long time without thought of refrigerant hazard. They were, of course, equipped with relief valves, and often with automatic switches to stop the compressors if the pressure went too high. A great many of them, however, are not yet equipped with the latest safety devices, new-type shaft seals, or adequate engine-room ventilation. The buildings or engine rooms in many cases are not of fireproof construction as we know it today, and many of the pressure vessels are not welded in accordance with the present ASME Code. In spite of this, I venture the opinion that serious accidents involving injury or loss of life have been extremely rare. With the best modern equipment and installation practices there is no practical reason why ammonia refrigeration cannot meet the highest safety standards for use in indirect systems.



Water coolers and ammonia compressors in machinery room of Oklahoma Gas and Electric's Oklahoma City office building. A tower on the roof cools condensing water

Not all consulting engineers have overlooked the advantages of ammonia refrigeration in air conditioning. There are many creditable installations both in this country and abroad and a brief look at a few of them will show how designers have capitalized on ammonia's advantages and overcome its apparent disadvantages.

The air-conditioning installation at the G T Murphy department store in Harrisburg, Pa., constitutes a fine example of what can be done with ammonia refrigeration. Arthur MacGonagle, consulting engineer of Pittsburgh, designed the system. A 10x10-in. duplex ammonia compressor, driven by an engine-type synchronous motor of 250 hp, supplies the refrigeration. The motor is mounted between the two compressors which have a total of four cylinders and are equipped with automatic capacity controls. They also have automatic unloading devices, so that the motor will start the machine any time the thermostat in the chilled-water line calls for refrigeration.

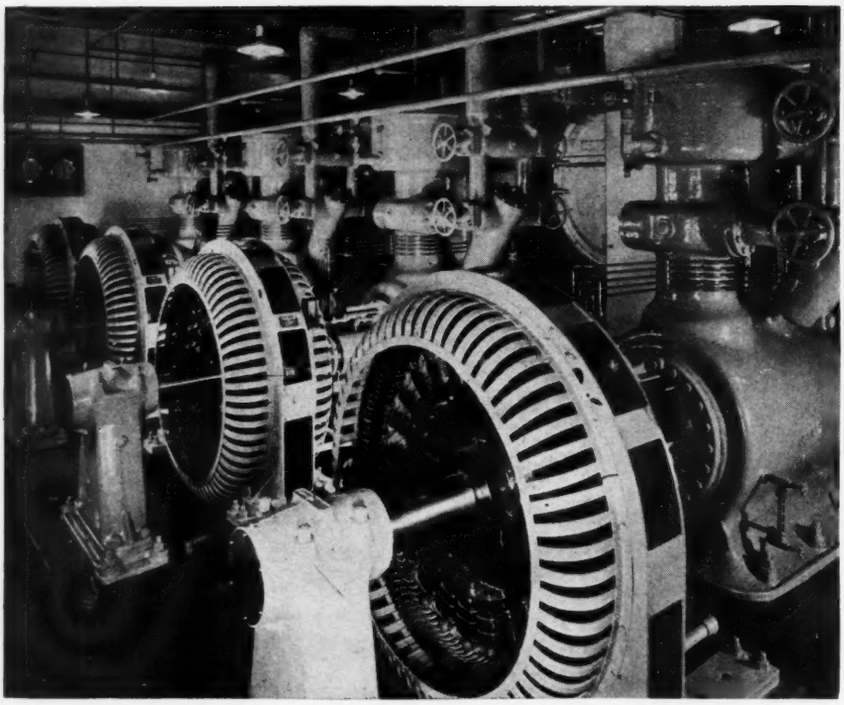
Oil pressure, regulated by a separate oil pump, operates the automatic capacity control used on this machine. There is a valve at the side of each cylinder, connected to a piston by a steel rod. Oil forced against the piston opens the capacity control, and oil pressure behind the plunger closes it. The valves can be operated by hand when necessary.

A tower on the roof cools condensing water. A horizontal multi-pass cooler in the engine room chills water for the air-conditioning units to 45 F. Safety devices consist of a high-pressure cutout, low-pressure switch, relief valves, and a backpressure regulating valve to prevent ammonia temperature in the cooler from going below 32 F.

In addition to these safety devices, the engine room is equipped with an exhaust fan, having a capacity of 5000 cfm. This emergency unit can quickly change the air and thus forms an extra precaution against the effects of refrigerant leaks. Ducts carry the exhaust of this fan to a point above the building roof.

Sattler's Store, Buffalo

At Sattler's department store in Buffalo, N. Y., placing the refrigerating equipment in a penthouse on the roof simplified elimination of refrigerant hazards. This "$150,000 Weather Plant", as a Buffalo newspaper described it, was designed by Edward E Ashley, of New York. Four 8 x 8-in. and four 6 x 6-in. ammonia compressors produce the required refrigeration, having a total capacity of 480 tons of refrigeration. Eight evaporative con-



Four motor-driven ammonia compressors with a total capacity of 1000 tons supply the air-conditioning systems of Philcade and Philtower Buildings, Tulsa, Oklahoma

densers liquefy the high-pressure gas. Water is chilled in three shell-and-tube coolers in summer; three water heaters provide for winter operation. The actual air treatment is accomplished with 40 individual cooling units supplied with cold water in summer and hot water in winter by two 30-hp pumps.

Steel beams on the roof carry all this equipment, and a penthouse 80 ft long and 50 ft wide encloses it. To support the 110 tons of machinery, steel work under this section of the building was reinforced by plates welded to the present beams. A reinforced concrete floor 8-in. thick gives a solid foundation. Special machine foundations, mounted on isolation cork above this floor, successfully eliminate noise and vibration.

Baltimore, Md.

There are a great many small air-conditioning installations using ammonia refrigeration with the same success as the larger plants. In Baltimore, Maryland, two theatres were air conditioned several years ago using ammonia systems. Each of these has a capacity of 45 tons of refrigeration and both were installed by the Paul J Vincent Co. Based on the successful operation of these two systems, there will be two new 80-ton installations in Baltimore, ready for next season.

The first of these 45-ton ammonia-refrigerated air-conditioning systems was installed in the Cluster Theatre in 1932. For the six years since that time, maintenance has averaged $15.10 per year. This includes cost of labor for starting the plant in the Spring and shutting it down in the Fall, as well as necessary oil for compressor and motors, and a total of 50 lb of ammonia, which sufficed for six years. The plant is automatic in operation.

Satisfactory operation of its first ammonia system led the Oklahoma Gas and Electric Co to choose the same type of equipment when they air conditioned the remaining four stories of their Oklahoma City office building. The original installation, made in 1934, supplied the first and fifth floors; two 6 x 6-in. ammonia compressors handled the refrigeration.

For cooling the 35,000 sq ft of the remaining stories, a 12 x 12-in. compressor was installed. This new machine is equipped with automatic capacity controls and automatic unloading valve, and is cross-connected with the two 6 x 6-in. compressors.

Arranging the three machines with a step controller permits obtaining almost any desired capacity.

The system is designed to maintain a dry-bulb temperature of 80 F and 50% relative humidity inside, when the outside summer temperature is 95 F and the humidity 44%. Air conditioners suspended in a fan room on each floor supply the offices through duct work. Compressors are located in the basement, water chilled in a horizontal multi-pass cooler being pumped to each floor. A tower on the roof cools condensing water.

Probably the outstanding ammonia-refrigerated air-conditioning plant in the country, with regard to size and safety, serves the Philcade and Philtower Buildings in Tulsa. This installation was designed by the Clifford H Carr Co, of Kansas City, and has a capacity of 1000 tons of refrigeration. Combined refrigerating equipment for the two buildings is located in a basement, with water coolers, condensers, and compressors in the same room. This space is isolated from the remainder of the building and is provided with an exhaust fan which operates continuously, serving both to cool the engine room and to prevent ammonia gas that might escape from entering building.

Equipment at Tulsa

The refrigerating equipment consists of four 12 x 12-in. ammonia compressors, each driven by a 200-hp engine-type synchronous motor; two horizontal spray-type water coolers; float-type refrigerant control valve; refrigerant liquid pump; and liquid ammonia receiver.

The spray-type water cooler installed here constitutes a departure from the conventional flooded cooler, and reduces the amount of ammonia required in the system. On this 1000-ton plant the charge is only about 1000 lb instead of the 7000 lb usually needed for a flooded system of the same size. The float control valve maintains a liquid level just above the bottom of the cooler shell and the refrigerant pump circulates the liquid from a sump on the bottom of the cooler to the sprays which keep the tubes covered with a liquid film.

The conventional safety devices are provided and relief valves are piped to a diffuser on the roof of the building. The relief line also has a connection to a manually operated valve for dumping the entire ammonia charge into a water mixer leading to the sewer, in case of fire. Compressor shafts are equipped with flexo-seals to eliminate even the small leaks sometimes found during shutdown periods when conventional packing is used, as well as to avoid hand adjustment of the several stuffing boxes. Although such seal leaks are not thought hazardous in commercial refrigeration, it is important that any ammonia odor be eliminated in air-conditioning work, even in the engine room. The flexo-seal was first developed to prevent shaft losses from Freon-12 compressors and has been adapted to ammonia and other refrigerants with excellent success.

LETTERS FROM A TURBINE SPECIALIST

No. 3—On Turbine Foundations

By F S KOHL and L E GRUBE
General Electric Co, Lynn, Mass.

Turbine Specialist
District Office
Dear Mr Specialist:

As you know, we expect to purchase a 3000-kw condensing turbine-genarator set sometime next spring. In order to complete my preliminary studies, I want to make a rough layout of the foundation required for the unit. What type of foundation would you suggest? Are there any special points that should be taken into account in its design?

I will appreciate any comments or recommendations that you can give me.

Sincerely yours,
Engineer

Dear Mr Engineer:

Local conditions must be considered in deciding upon the foundation best suited to your installation and in working out the details of its design. It is impossible to make specific suggestions without complete knowledge of these conditions, but here are some comments which may help in preliminary studies.

You will probably find that the structural-steel type will give you maximum economy of space. This may be somewhat at the sacrifice of cost if a highly rigid foundation is to be obtained. The old solid-concrete foundation gave the desired mass and rigidity, but it was very inefficient in the use of space inasmuch as the condenser, air coolers and auxiliaries had to be installed off at one side rather than beneath as in modern installations. A good compromise between these two types is the reinforced-concrete foundation. This type is popular with the majority of turbine users because it meets the requirements of simplicity of design and construction, necessary rigidity, fair accessibility and economy of space at reasonable cost.

I am enclosing a rough plan of a typical foundation with the turbine-generator set, its condenser, air coolers and ventilating duct work shown in their conventional positions. This plan shows the reinforced-concrete type, but the general arrangement of a structural-steel foundation would be similar.

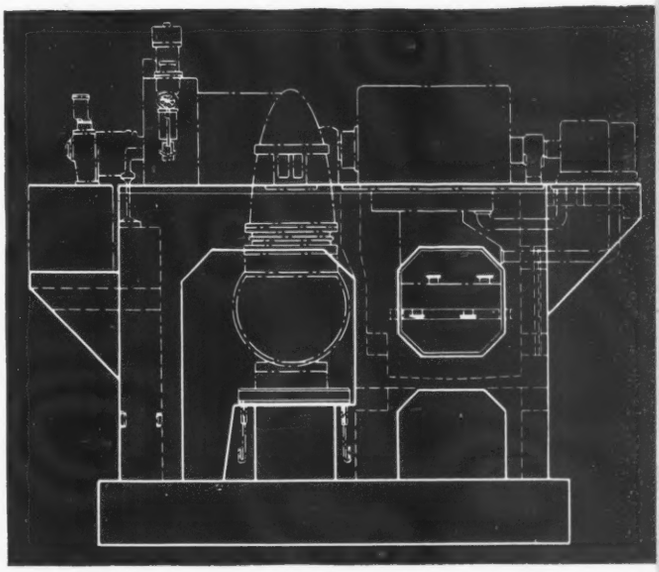
There is one basic criterion to remember in the design of a turbine foundation: *Deflection*—not stress—should be used as the limiting feature in your calculations. You can readily understand why deflections in the supporting members must be very small. Any appreciable deflection might cause warpage of the turbine casing or a general misalignment of the unit, and serious operating difficulties would result. In checking foundation designs we quite frequently find members with very reasonable stress, but with deflections entirely too great.

As a general rule we recommend that maximum allowable deflection at any supporting point be limited to 20 mils. The closer this is to zero the better. The load on which this deflection is based should be made up of the sum of (1) dead load, (2) vacuum load (for condensing units), (3) weight of the foundation members involved, and (4) an assumed impact load. This latter item is usually taken as ½ of the dead load at the point in question. Horizontal rigidity is as necessary as vertical stiffness, and is accomplished by cross bracing and column reinforcement. Construction should be such that the horizontal deflection at the foundation deck at right angles to the turbine shaft is limited to 20 mils, assuming the force to be the impact load used in the calculations for vertical deflections.

While the impact load is more or less an arbitrary one, experience has proven that, by assuming it as half of the dead load, satisfactory designs are obtained. If your method of calculating does not include this item in the loading, it can be taken into account just as well by the use of an additional factor of safety.

In your design work, make sure that there is no interference between the foundation and the piping, duct work, auxiliaries and other parts. If the columns cannot be extended to bed rock, a reinforced-concrete mat is recommended. Piling might be required under the mat.

If you select the structural-steel type, here's an additional point to keep in mind: Temperature differences between various parts of the foundation may cause sufficient unequal expansion to distort or misalign the unit. For example, this difficulty might occur if a hot steam line is passed much closer to one column than to the others. A localized cold air draft would have the same effect. Heat-insulating the members, especially the vertical columns, will avoid difficulties of this type. Encasing in concrete has proven satisfactory.



In a typical reinforced-concrete foundation, columns are usually carried on a single concrete mat. Note condenser space and cross braces for horizontal stiffness

If local conditions permit, your foundation should be constructed entirely separate from the station floor or any part of the building structure. This will largely prevent the transmission of any possible vibration either to or from the unit.

These comments are by no means complete; however, they may give you an idea of some of the major points involved. The main thing to remember is that a good foundation contributes a great deal to the successful operation of a turbine or turbine-generator set. Care taken in its design and construction will be more than repaid during the years of life of the unit.

Very truly yours,
Turbine Specialist

Testing Dust Collectors

Getting accurate collector efficiency has pitfalls for the unwary. Here are practical thoughts based on recent tests

By JOHN E WATSON, *Prat-Daniel Corporation*

IT IS EASY ENOUGH, and will soon be even more simple, to write into a specification for dust- or cinder-collecting apparatus a clause that equipment must meet efficiency guarantees as to quantity and fineness of material discharged over the entire load range. A few more words can make provision for testing the installation at several points withing its gas-flow capacity.

Control of dust emission from stacks is now an accepted necessity in all types of power plant near centers of population. The need for obtaining accurate results of actual collection efficiency in place naturally follows. A new ASME Code is in preparation and will soon become the accepted standard for methods of efficiency determination.

However, getting accurate and acceptable measurement of dust-collector performance is not always direct and certain. First, the quantities of dust entering or escaping the collecting apparatus usually are determined by sampling. Any disturbance to smooth flow, such as a sharp turn in the flue, can make such sampling difficult, expensive and possibly inaccurate even when carried out by engineers thoroughly experienced in this field. Secondly, accumulations of dust in horizontal runs or pockets are affected by changes in boiler load and thus introduce an added and frequently serious complication.

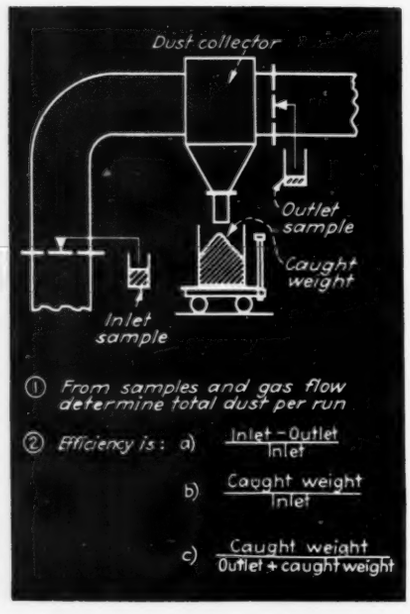

Dust collector
Outlet sample
Caught weight
Inlet sample
① From samples and gas flow determine total dust per run
② Efficiency is: a) Inlet − Outlet / Inlet
b) Caught weight / Inlet
c) Caught weight / Outlet + caught weight

Fig. 1—Efficiency can be determined from any two of three measured quantities

Collector efficiency can be determined from any two of three measured quantities, Fig. 1. These are, quantity of dust at the inlet, corresponding amount at the outlet, and caught material. When the latter can be weighed, the difference between the first two quantities can be checked by the amount of catch.

When the inlet and outlet dust quantities are determined by sampling the gas flow, the efficiency is found by subtracting outlet loading in grains per cubic foot from inlet loading in the same units and dividing by inlet loading. Obviously, the difference in grain loadings, when multiplied by the total gas flow, should check the caught weight. Trouble comes when they do not check, which, unfortunately, is too often.

Of these three, the caught weight is least subject to error, if the hopper is cleaned before and after testing, if conditions are uniform and if the test is long enough. The error, if present, must be in either the inlet or outlet sampling. Furthermore, inlet quantities are large and an error makes a large difference in the efficiency; the same percentage error in outlet sampling has a much smaller effect on results, Fig. 2.

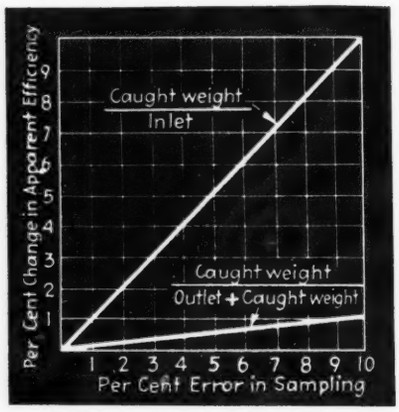

Per Cent Change in Apparent Efficiency
Caught weight / Inlet
Caught weight / Outlet + Caught weight
1 2 3 4 5 6 7 8 9 10
Per Cent Error in Sampling

Fig. 2—Approximate error in apparent efficiency, assuming no error exists in the caught weight and that the error makes sample too small. Note increased accuracy when outlet sample is used

Specific Difficulties

To illustrate specifically some of the difficulties found in the field, our experience in testing installations during the past year has brought up some situations that might profitably be reviewed by potential purchasers of dust-collecting equipment in the light of the proposed Code. Here are three.

One large industrial plant in the Midwest, fired with pulverized coal, has breeching laid out as in Fig. 3. From the first investigation of sampling points, it appeared that accurate results could be obtained fairly rapidly with inlet samples taken from the horizontal run after the air heater. The straight, vertical run at the fan discharge was chosen for the outlet sampling location because of the bifurcated connection between collector and fan inlet.

Plant operating conditions limited test loads to about 60,000-lb-per-hr steaming rate on a 90,000-lb-per-hr boiler. Testing took several weeks during which load dropped to 25,000 lb per hr at night. Twenty inlet sampling points were installed.

Observations of dust collection in the horizontal flue showed about 4-in. filled of a total 24-in. height. Fluctuations in steam requirements over twenty-four hour daily operation prevented a uniform deposit and the first tests showed wide variations in the samples taken. Cleaning the flue prior to test only resulted in rapid settling during the test period and low dust-concentration readings. A spot-light system showed the dust sliding along the bottom of the flue despite the fact that the elbow at the air-heater outlet theoretically had a tendency to throw the dust to the upper portion of the flue. After a week of testing the inlet location was abandoned.

At the outlet, due to the tests being

run at only two-thirds boiler capacity and the fans being driven by constant-speed motors, the fan dampers were partly closed. This resulted in extreme variations in gas velocity at any cross section of the flue and no reasonably constant results could be obtained. This condition required changing outlet sampling to the connection between dust collector and fan where relatively uniform velocities were encountered.

Since it was apparent that no accurate inlet samples could be obtained, efficiency was finally determined from outlet samples and caught weight. Fourteen consecutive days of testing at varying load gave satisfactory results.*

Another installation, Fig. 4, had a vertical inlet flue which yielded fairly accurate sampling. However, the flat flue over the collector accumulated dust of varying thickness over a boiler load range of 4-to-1, seriously affecting the outlet samples. The boiler had been shut down for several months previously; in addition, steam had to be blown to atmosphere during test as there was no use for it at the time which made it impossible to spend more than two weeks testing. The result was that no reasonable checks were capable of being obtained at that time. This indicates that the prospective purchaser should not have too optimistic an opinion as to the speed, the expense, or even the feasibility of a test in every instance.

A third series of extensive tests were run on a 125,000-lb-per-hr stoker-fired boiler in a central station with the layout shown in Fig. 5. The 6-ft diameter discharge stack was a temporary installation to obtain an accurate outlet sample. Even this had its drawbacks.

No good location existed between fan and dust collector for inlet sampling. More dust was collected from the hopper than was indicated by the inlet samplers. Probably the coarser particles slid along the outer walls of the breeching. As a result of preliminary tests, inlet sampling was abandoned and efficiency was established from outlet samples and caught weight. It should be recognized that it is not always easy to collect and weigh the dust in a hopper unless provision is made at the time of installation. Provision for collecting and weighing the dust should always be made on at least one unit even if inlet sampling appears feasible.

In this particular case, tests of the dust loading had been run several months prior to installation of the collectors at various ratings. Fortunately, these checked the total dust in the gas as determined from caught weight and outlet samples observed during the collector tests.

As for the temporary vertical outlet flue, installed especially for testing, the horizontal flue, forming the outlet of the cyclones, accumulated dust at night when the collectors were bypassed to allow natural-draft operation of the boilers. When rating was brought up in the morning at the start of testing, this accumulated dust falsified the outlet sample. Running the boiler at test rating an hour or two before sampling removed the accumulation of dust and increased the apparent collector efficiency about 4%.

* *Combustion*, Sept., 1939.

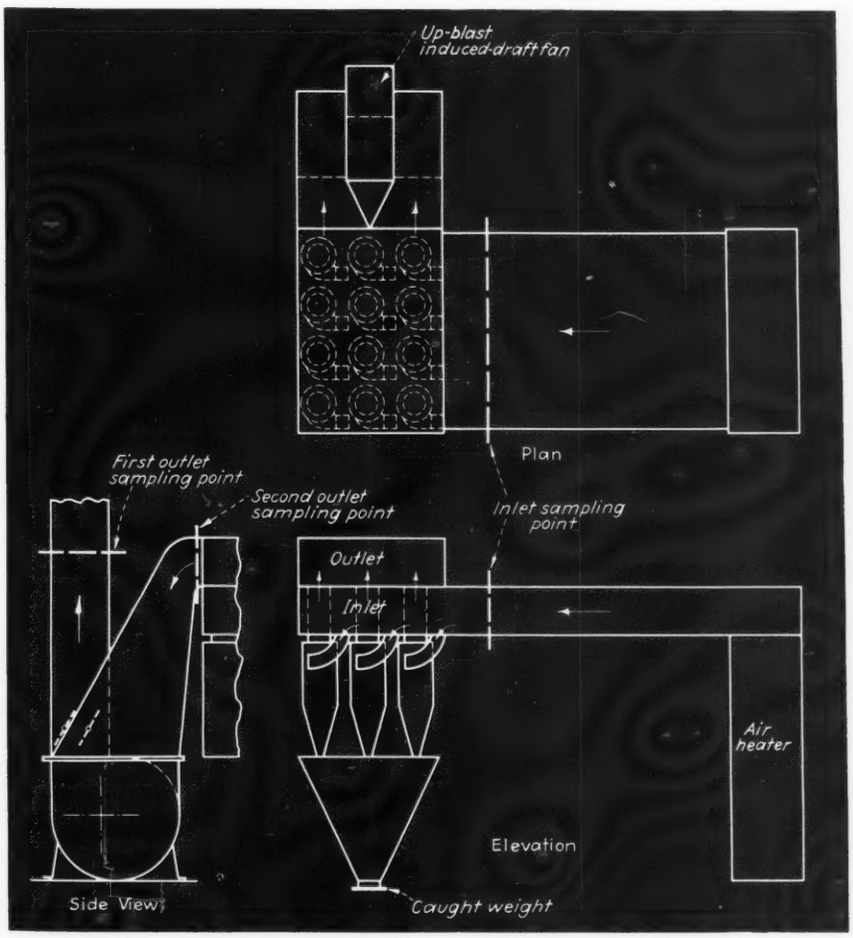


Fig. 3—An actual situation where inlet samples were inaccurate. Efficiency was finally calculated from caught weight and outlet measurements

Skill and Experience

It takes both technical skill and experience to get consistent and accurate sampling. Whatever method is used, and there are several varieties of equipment that have proved out in practice, results can be no more accurate than the sample of gas withdrawn from the flue. If the sample is taken at a lower velocity than the travel of the gas in the portion of the flue being sampled, a portion of the dust will be projected, due to its momentum, into the sampler-tube opening and the dust loading in the sample will be greater than that in the main gas stream. Conversely, sampling at too high a velocity yields too low a dust loading. An idea of the magnitude of the error involved can be had from Fig. 6.

In practice, conditions of sampling are far from ideal in nearly all instances, because, of course, flue layout is designed within physical space limitations and long, straight runs are conspicuously infrequent.

Consider the sampling problem posed by the horizontal flue from air preheater to collector shown in Fig. 3. Velocities in such a flue will generally be low due to the physical size of the air heater, and dust may settle in the bottom of the flue to a depth of several inches. When manipulating a sampling tube near the bottom of the flue, even a very slight stirring up of the dust by the sampler or by turbulence of the gas will seriously contaminate the sample.

Even with a combined cyclone-and-cloth sampler, the volume of gas and quantity of dust withdrawn are extremely small. For example, in one 4-hour test, 22 cfm were withdrawn in a sampling tube and the dust collected amounted to about 30 ounces at the inlet and less than 3 ounces at the out-

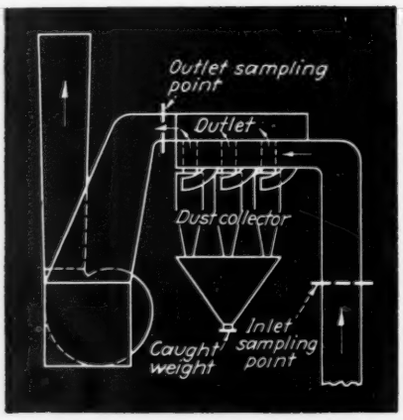


Fig. 4—Although vertical inlet gave good sampling conditions, dust accumulation affected outlet readings

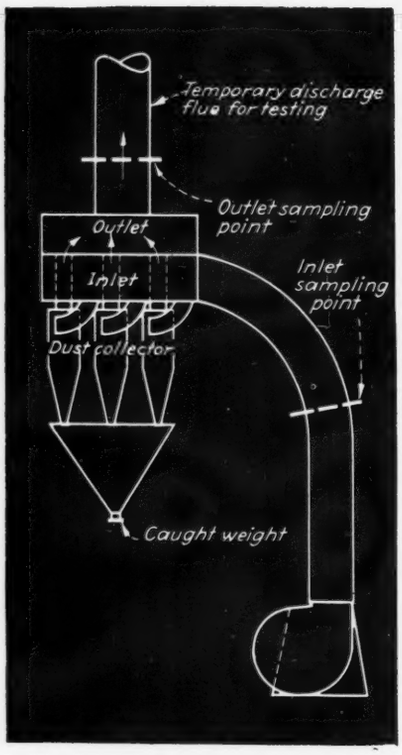


Fig. 5—Curved inlet resulted in poor sampling. Temporary outlet stack gave satisfactory readings after short-time high rating blew out dust accumulation

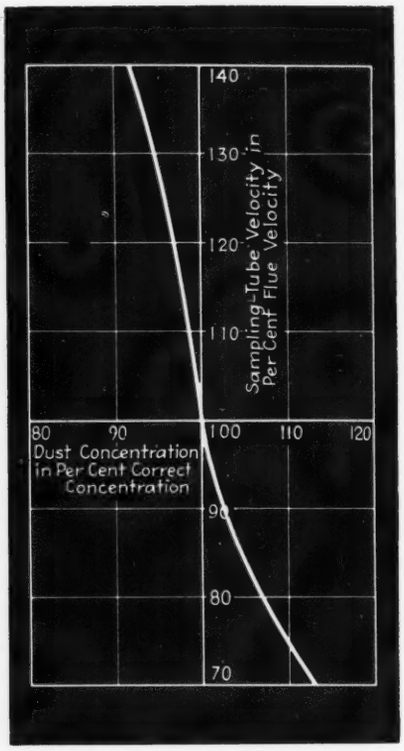


Fig. 6—Error made by sampling at too high or too low gas velocity, determined experimentally with a 1-in. tube. Note magnitude of the error involved

let. It would take only a small quantity of scooped-up dust to affect results seriously. With other equipment even smaller samples are taken and the effect of scooping is even greater.

In a series of tests at several load points, proceeding from low loads to high loads, settled dust accumulations tend to increase the apparent dust loading of the gas; if high loads are tested first, the reverse is true. It is extremely difficult to determine when the saturation point of settling is exactly reached. Practical considerations are more than likely to prevent long enough constant-load operation before a test so that saturation is reached even if length of period required were known.

The obvious answer is to utilize vertical flues where possible. Even then, any horizontal flue-section between inlet and outlet sampling points is liable to store dust and cause errors from pick-up or precipitation.

Bends of any type before a sampling position are definitely likely to stratify dust of various sizes and the stratification will be apparent for a considerable distance after the bend. This may not be a serious condition except where the dust is coarse enough to slide along the breeching walls as with stoker installations. If this is the case, no sampling tube can catch a fair sample.

Fortunately, mechanical dust collectors almost completely eliminate larger-size particles. The difficulty is, therefore, much less pronounced at the outlet sampling point. However, the danger of pick-up along the bottom of a horizontal flue is extremely important at the outlet sample because the amount of dust collected is so small.

Many difficulties beset the way of the engineer attempting to test a dust collector. Furthermore, these difficulties cannot all be classified before testing and will vary greatly depending on the layout of flues as well as the type of dust collector. It requires not only expert technical assistance but a great deal of experience on the part of those conducting the tests to obtain reliable results. Even under best conditions, tests are subject to considerable experimental error; under unfavorable conditions the difficulties may be insurmountable.

Exhaust Lines

The latest thing in super-filter, no-gook-in-a-pipeful, sinless smoking pipes is the 2-cylinder Zeus model, recently announced by a New York firm. A cigarette is cut in half and the two pieces inserted in the broad hollow aluminum stem of the pipe. Smoke from the bowl passes through the cigarette to be freed of tar and juices. The filtering cigarette and cooling-condenser effect of the large aluminum chamber gives a smoke said to be cool and dry, yet not flat. And, says the manufacturer, the condenser of this double-barrel job has a cooling area of almost 5 sq in., largest ever built into a pocket pipe. No mention was made of the steam-generating capacity.

By L N ROWLEY

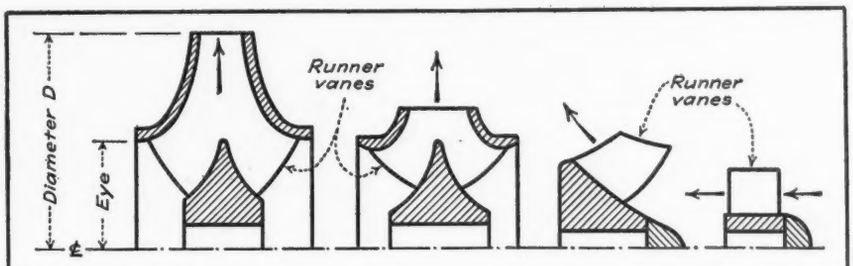
A gentleman from Logan, West Va., who lives next door to a new power plant, sued the company for $40,000, claiming that the generator vibration was shaking his house down. The jury returned a verdict in his favor—for $1. Must have been quite a house!

At the recent fuels meeting in Columbus, Ohio (see page 84) A G Christie told a story that shows why engineers' hair sometimes turns grey. It seems that some years ago, the chief of a municipal plant was trying to get an appropriation for badly needed equipment. The town council, of course, had control of the purse strings, and debated at some length on the problem. One old codger got up and said, "I'm going to vote against this proposition, and I'll tell you why. Last year, we provided money for a new smokestack, and I've been watching that stack for ten months, but I'll be durned if I've seen any smoke come out of there yet!"

Twenty-five years ago, the great German strategist General Von Moltke said, "Every war is a national calamity whether victorious or not". Sometimes it looks like we can't learn from experience, no matter how dearly bought.

Which Pump for Circulating Water?

By A I PONOMAREFF
Westinghouse Electric & Mfg Co



Type	Centrifugal	Centrifugal	Axial Flow	Propeller
N_s	1,250*	2,200*	6,200	13,500
GPM	2,400	2,400	2,400	2,400
Head	70	48	33	20
RPM	870	1,160	1,750	2,600
D	19	12	10	7
R	0.5	0.7	0.9	1.0

* *Based on single suction*
N_s – *Specific speed, rpm;* D – *Runner diameter, inches;*
R – *Ratio of eye to runner diameter*

Fig. 1—Comparison of circulating-water pumps on the basis of specific speed

CENTRIFUGAL, axial-flow and propeller circulating-water pumps for steam condensers have been built to handle flows of 500 to 100,000 gpm at heads suitable for either single- or multiple-pass units. Fig. 1 compares the three types on the basis of specific speed, defined as the speed at which a geometrically similar imaginary model pump would deliver 1 gpm at a total head of 1 ft. The table of Fig. 1 shows that the specific speed of a pump may vary within wide limits, depending on the type of runner.

A pump of low specific speed has a narrow runner, radial vanes and a small ratio of eye to runner diameter. It is essentially a high-head, low-capacity, slow-speed pump. With increased specific speed, the runner becomes wider in proportion to its diameter, and the ratio of eye to runner diameter increases until it reaches unity for a propeller pump. Then we have an extremely high-specific-speed, low-head, high-capacity, high-speed pump of comparatively small dimensions.

As specific speed increases, pump-operating speed goes up and physical dimensions of the pump become smaller. Fig. 1, showing four runners of various specific speeds, illustrates this very clearly. Note also that in the centrifugal pump, water in the runner is directed at a right angle to the pump shaft. In the axial-flow unit, flow is at an acute angle to the pump shaft, and in the propeller type, it is parallel to the shaft. The character of the flow in the runner of axial-flow and propeller pumps permits elimination of a discharge volute around them, thereby decreasing their over-all dimensions. Guide vanes at the runner discharge eliminate rotational component of the water.

Characteristic curves of these three pumps show substantially the same maximum efficiency. There is, however, a material difference in the slope of their head-capacity curves; the steepest is the propeller-pump curve, the flattest is that for the centrifugal pump. Operating experience from many stations using propeller pumps for condenser circulating-water service indicate that this steep head-capacity characteristic is advantageous in starting, as it eliminates necessity of priming the circulating-water circuit.

Recent developments in steam-turbine design have reduced the space required for a given output. This has cut down the floor space available for the condenser and auxiliaries, and has brought about a decided trend towards higher-speed, vertical circulating-water pumps.

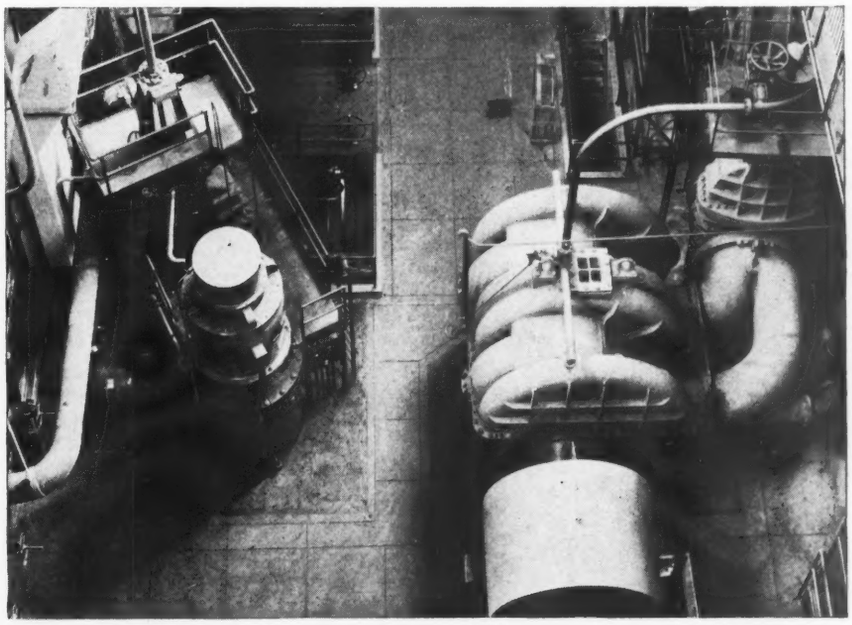


Fig. 2—Vertical propeller pump (left) has same capacity as horizontal-shaft centrifugal unit (right), but occupies much smaller floor space

Kilowatts Out of Douglas Fir

World's largest wood-fired power plant is 77,500-kw "Station L" of Portland (Oregon) General Electric Co. Special equipment and operation develop four kwhr per cu ft of hog fuel

By PHIL SWAIN
Editor of POWER

ON my recent western trip I spent several days in Portland, Oregon, a city largely supported by various products of the giant Douglas Fir of this big-tree region. To the people of this Oregon metropolis the Fir is bread and butter—also power and light, for sawmill waste is a major fuel of its central power plants.

Directly across the Willamette River from the heart of the business district is Station L, of Portland General Electric Co. In the plant yard stands a young mountain of hog fuel, mainly Douglas Fir sawdust and chips.

A good year's consumption of this fuel would make a pile 200 ft square and 1250 ft high—50,000,000 cu ft. But power men and lumber men in the Pacific Northwest don't think of wood waste in terms of cu ft. They buy and sell hog fuel by the "unit" (200 cu ft).

Heat value of a "unit" varies greatly with the type of wood, its condition and moisture content, but the high heat value for Douglas Fir hog fuel runs up to about 16,000,000 Btu per unit, "as fired." Station L extracts from each unit about 800 kwhr (net) day in and day out. The high-pressure end of the plant can develop 870 kwhr per unit.

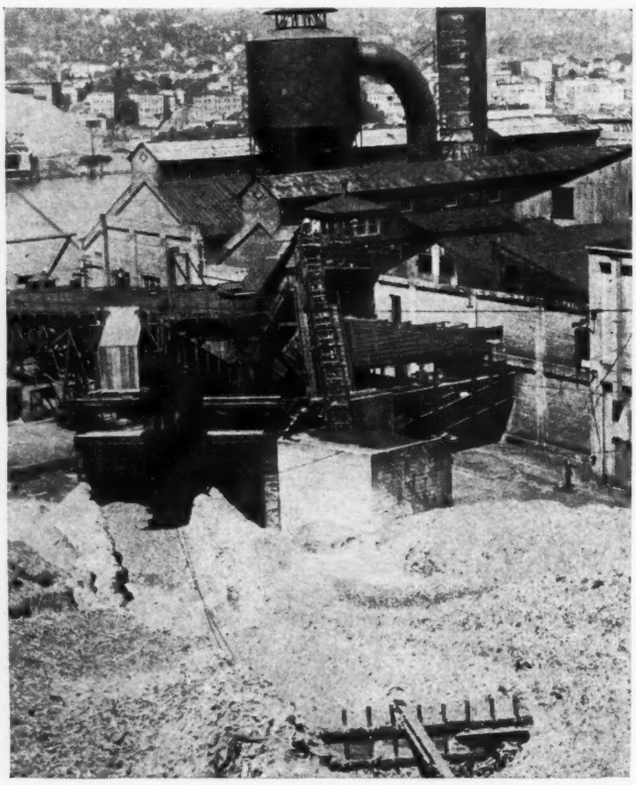
Right behind the fuel pile stands the Inman Poulsen Lumber Co, whose waste conveyors discharge directly to the pile. Most of the remaining hog fuel burned comes in by barge and a little by truck.

Since 1910, when Station L was built, the plant has operated chiefly on hog fuel, with oil as secondary fuel. In 1925 the plant consisted of twelve 4500-sq-ft (200-lb pressure) boilers serving a 2000-kw condensing Corliss and turbines of 12,500, 2000 and 6000 kw.

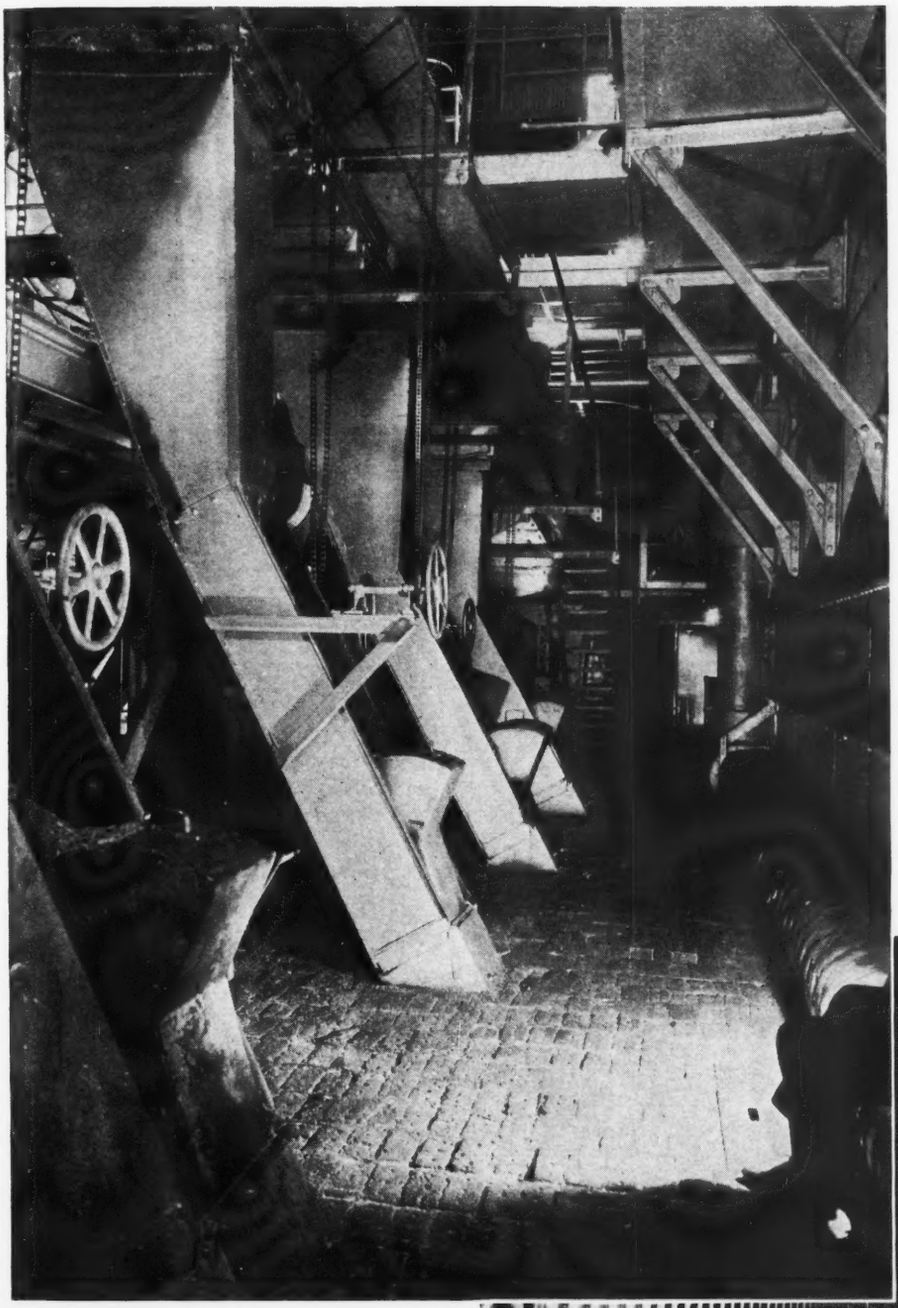
During the next two years the plant was modernized by adding a 220,000-lb-per-hr Stirling boiler designed to generate steam at 425 lb and 720 F for a new 20,000-kw turbine. For a time it was necessary to operate this turbine and boiler, and two of the old boilers, at 250 lb to insure ample capacity.

This condition was remedied in 1930 by the installation of a second Stirling boiler (400,000 lb per hr at 425 lb) and a 35,000-kw turbine. Waterwalls were installed in the first Stirling, and auxiliary oil burners in the second.

Barges bring hog fuel from big lumber mills via Columbia and Willamette Rivers. Bridge crosses Willamette



Cable-pulled rake drags chips up and down the big pile; heavy chains pull wooden flights through a metal-lined trough



Handwheels control gate openings in bottom of conveyor trough. Hog fuel falls through chutes to conical piles on water-cooled stationary grates of Dutch ovens (8 Dutch ovens per boiler)

Since then, the two large boilers and the 20,000-kw and 35,000-kw turbines have operated at 425 lb and 720 F, as originally planned.

The latest modernization step (1938) was the installation of a 225,000-lb-per-hr, B & W, F-type, integral-furnace boiler (also 425 lb and 720 F). This is an oil-fired outdoor unit, with enclosed operating deck.

In a lumbering district, such as this, one naturally thinks of wood waste as a drug on the fuel market—a resource to be used freely with no need for conservation. Such is not the case in Portland. Station L needs oil fuel, not merely for emergency standby, but also to carry part of the regular station load for several months each year when lumbering activities cannot satisfy the local demand for hog fuel.

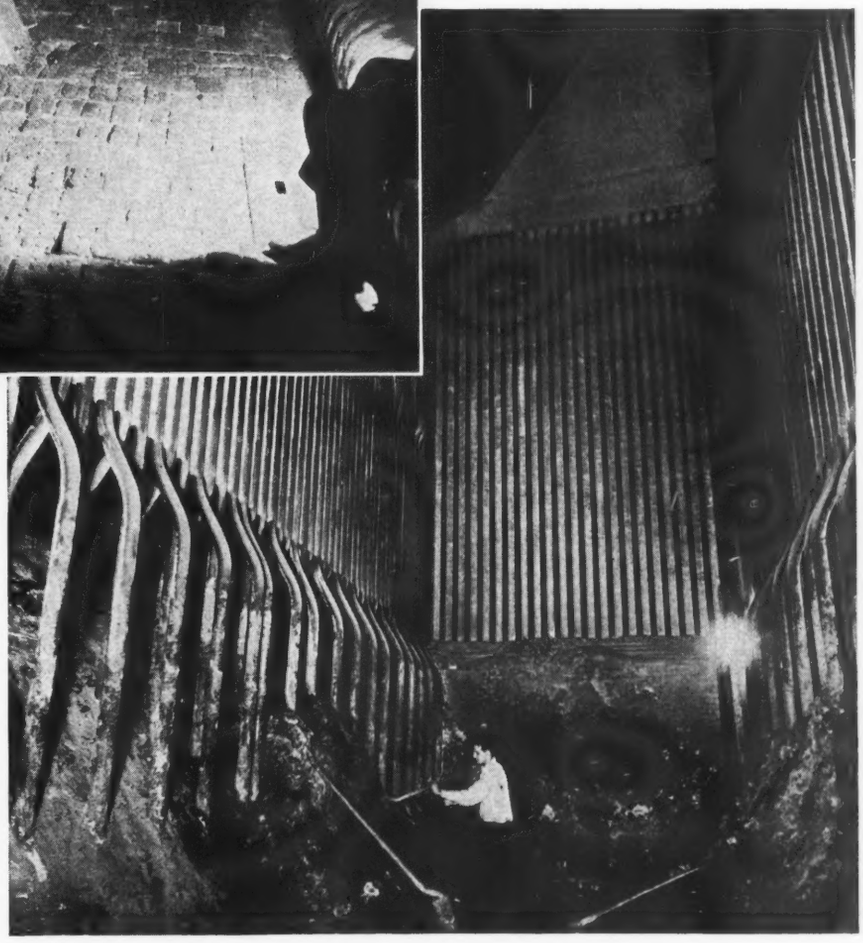
In Station L it is neither necessary nor practicable to shift instantly from one fuel to the other. Change from wood to oil on one of the Stirling boilers requires shutting the boiler down for a day to cool it and permit bricking up the bridgewall openings from the Dutch-oven cells.

Handling Hog Fuel

Except for the dock crane and drag rake on the fuel pile, the hog fuel is transported exclusively by drag scrapers—heavy chains pulling shallow wooden flights through a metal-lined trough about 30 in. wide.

Hog fuel brought to the plant dock in barges is lifted to the dock hopper by a clam-shell bucket of special design. It then goes either to the plant hopper or the storage pile.

The conveyor operator, from an elevated platform, regulates the feed of fuel from dock and pile to plant hopper and from plant hopper to the two boiler-



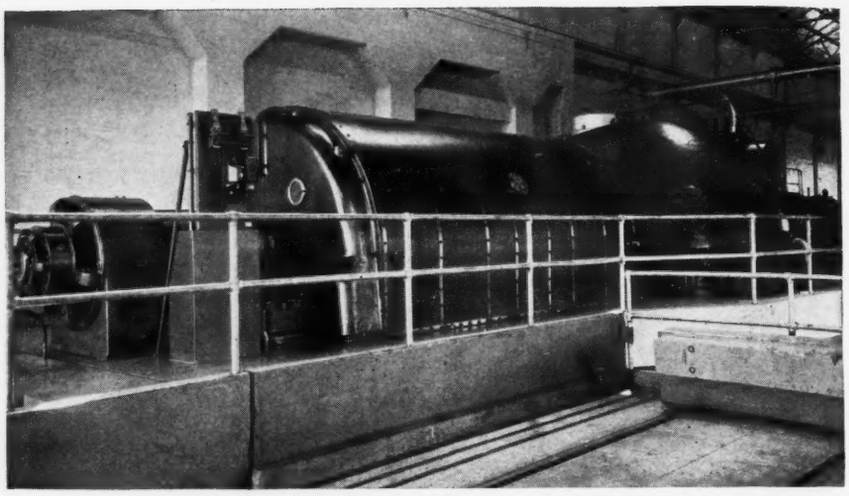
Cleaning furnace of largest Stirling boiler

feed conveyors, in which he maintains a constant fuel level, regardless of boiler loading. The fuel travels around the boiler room in two loops, one feeding the Stirling boilers, and the other the old low-pressure boilers (still operated to supply steam to Inman Poulsen Lumber Co).

The two loops join on the return run, which carries all fuel not chuted to furnaces. Using a proportioning gate, the conveyor operator recirculates this into the two loops, adding any necessary makeup to keep level constant.

The conveyor passes directly over the Dutch oven cells, of which there are eight on each Stirling boiler. Over each cell a handwheel-operated horizontal gate in the conveyor bottom controls discharge of fuel to the cell chute. Fuel accumulates in the upper part of the chute until its weight forces open a flap and dumps the load on top of the conical fuel bed. The flap then swings back to keep cold air out of the furnace. The operator adjusts the gate to keep the fuel cone at the right height, as seen through a glass in the chute.

The Dutch-oven cells have water-cooled grates of flattened seamless-steel tube welded into pressed-steel headers. Forced draft is used to overcome air-preheater resistance only, leaving a negative pressure in the oven. Draft is carefully controlled to avoid blowing light fuel over into main furnace.



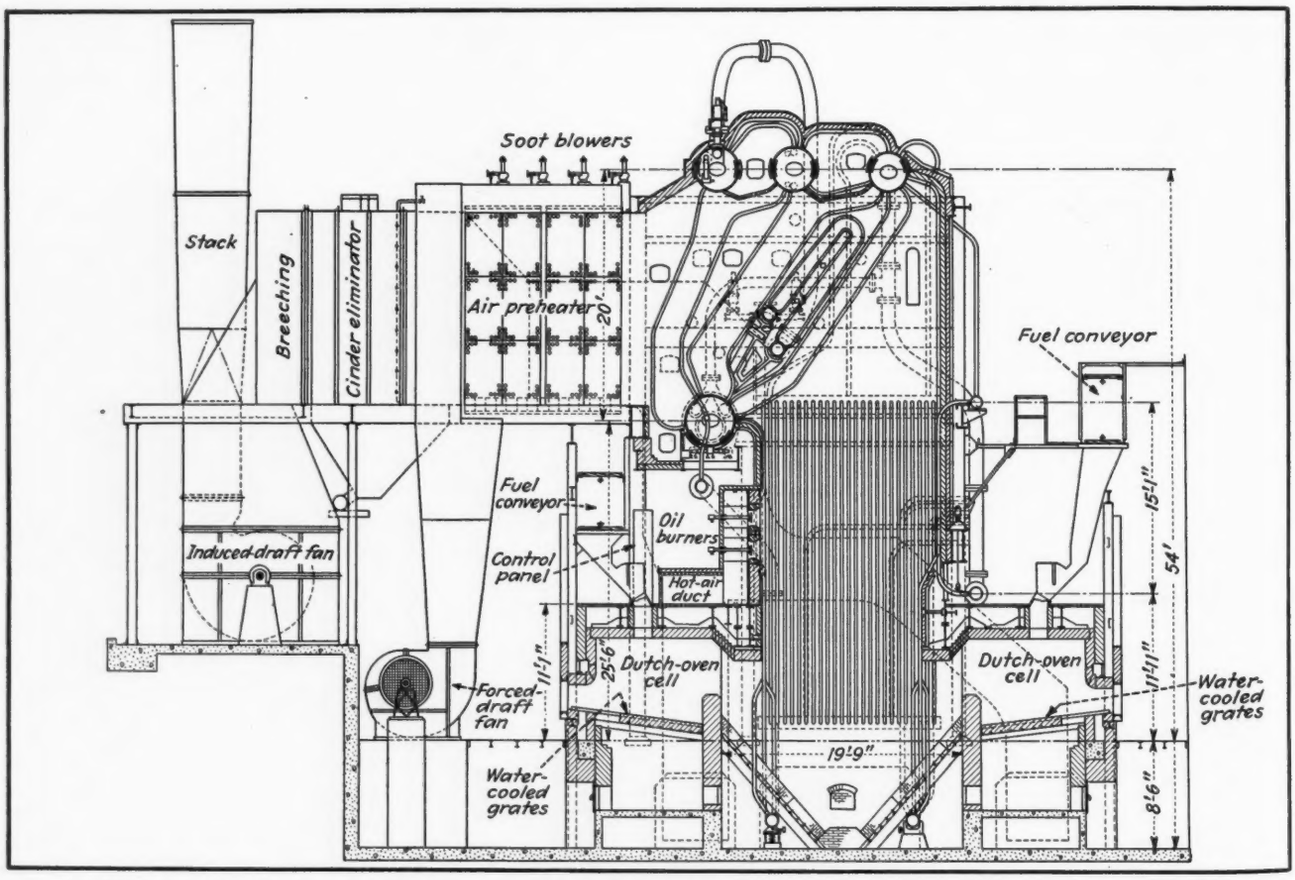
Largest turbine is 35,000 kw; plant capacity is 77,500 kw

During the grave-yard watch each night, the fires are burned down (one at a time) on the grates, which are then cleaned with an air lance. One man, with wheelbarrow, handles this cleaning job for the entire plant.

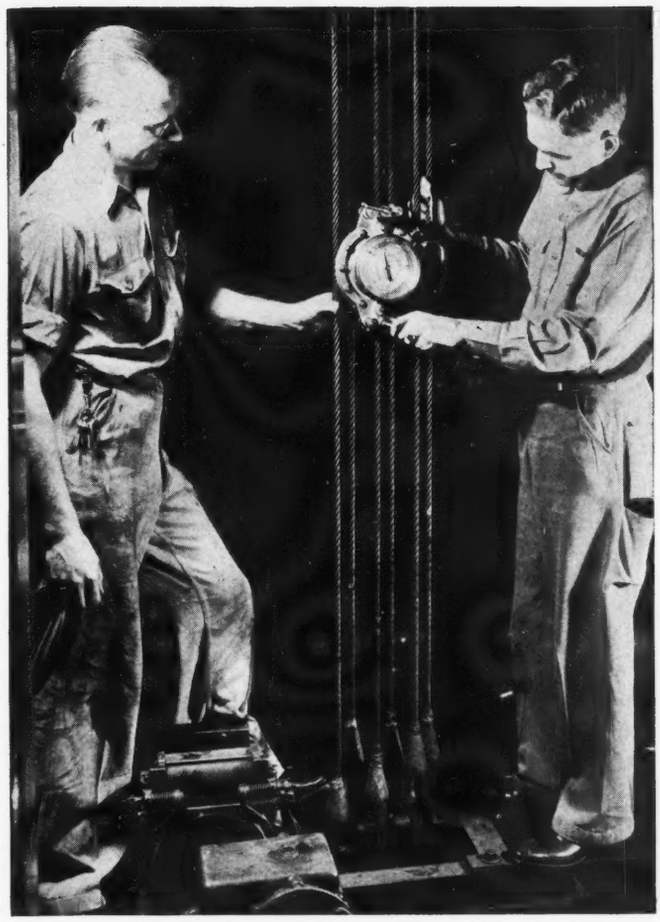
Stack cinders are removed by sprays and eliminator plates in the breeching between preheaters and induced-draft fans. Water and cinders pass to a continuous rotary vacuum filter. The cleaned water is discharged to the river, and the cinders go back to the fuel conveyors for refiring.

The hog-fuel pile at Station L might appear to be a fire hazard, but this is not the case. Tests prove that even a cordwood fire on top the pile will not ignite the sawdust and chips.

For help in assembling and checking the data here presented, I am indebted to chief engineer Walter Brenton, Portland General Electric Co, and to my guides at the plant, C E Coryea, mechanical engineer, and W E Briggs, chief steam engineer.



Fuel is burned in eight Dutch ovens, four on each side. For oil firing, arch openings from Dutch ovens are bricked shut



Tension meter checks proper load division on elevator hoist ropes

More Life for Elevator Ropes

Chief William Devaughn says, "Put machines in top condition and keep them there. Then ropes will live longer"

AT THE 70-STORY BUILDING, 40 Wall St, New York, N. Y., we have put in a lot of time and effort in increasing elevator rope life. On traction machines, it is well known that equal loading of the several hoist ropes is very important. Automatic equalizers have been developed for this purpose and used extensively, but we have used another method successfully.

In a few words, our formula simply amounts to putting elevators in first-class condition and keeping them there. Three years ago, we bought a tension meter to measure the loading on each hoist and compensating rope. With the readings obtained from this instrument as a check, we can be sure we are holding true to our purpose.

First off, we go over the traction and secondary-sheave grooves of each machine with a gage. Sheave shafts are also checked for level. Until these conditions are correct, there isn't much use in trying to keep hoist ropes equally loaded. A groove worn more than a companion causes unequal travel of the ropes; worn grooves may also pinch the ropes. Both of these actions contribute to short rope life.

When conditions at the machine satisfy us, we start at the car. First we release springs in the guide shoes so that the car hangs practically free on the ropes, and then adjust the shackles nuts until each rope is equally loaded. Important is the check on the car-sling crosshead for level, at the same time making sure that the center of the lift is at the center of the crosshead. We also level the car in its sling.

By properly balancing the car and equalizing the loading on the hoist ropes, we can use lighter and more resilient springs on the guide shoes. Only sufficient tension is put on the springs to hold the shoes with a light pressure onto the rails. Then, if the car and ropes are properly adjusted, the car has a floating action between the rails as it goes up and down the hoistway, assuming that the rails are in reasonably good condition.

After properly adjusting the car, we inspect the compensating ropes and sheave. It is essential that the traveling cables be supported from the bottom of the car to give equal distribution of weight. On a high-rise car, these cables are heavy, and if not properly supported, cause a heavy unbalance of weight on the car sling that interferes with smooth riding.

We also make sure that counterweights are in A-1 condition. In addition to keeping guide shoes and rails in good condition and holding them to the rail with a light tension, we see that ropes lift the counterweight from exact center of the crosshead.

After all equipment has been put into first-class shape, we start making final loading adjustment on the hoist ropes. We check the loading with the car at the bottom, in the middle and at the top of the hoistway. Adjustments are made to get approximately equal loading on each rope no matter what position the car is in.

When we can't get a satisfactory adjustment at the car, we bring the counterweights to the middle of the hoistway, where they can be worked on from the top of the car, and check rope loading near them. Several times, adjustments were made in this way that corrected unequal loading of the ropes.

Of course, adjusting rope loading is a compromise, because slight inperfections in ropes and sheaves cause small amounts of unloading as the car runs up and down the hoistway. We are, however, able to hold the rope loading to within quite close limits after a set of ropes has been in service long enough for it to get worked down.

To date, we haven't had a set of hoist ropes in service long enough to find out definitely just how much our efforts have lengthened rope life. So far, everything points to a very material increase. On three cars, ropes have been in service for 35,000 miles without showing any signs of fatigue. Signs point to another 25,000 to 30,000 miles for these ropes.

One thing we are sure of: Cars operate more smoothly, are easier to maintain and consume less power now than they did before we started keeping them up to snuff all the time.

Centralized Systems Unify the Lubrication Job

Oiling bearings individually consumes far too much time—with centralized pressure devices, up to 500 can be lubricated at one clip

By JAMES I CLOWER
Assoc Professor Machine Design
Virginia Polytechnic Institute

SEVERAL SYSTEMS deliver a measured quantity of lubricant under pressure to each bearing of a machine from a central pump. These are applicable to a wide variety of large and medium-size machines and the tendency is toward extending their use to light machinery, particularly where excess oil is detrimental to a manufactured product. They may be either hand-operated or automatic.

Fig. 2 shows a single-line hand-operated system and Fig. 1 shows a cross-section through the pump. Essential parts are oil reservoir, hand-operated pump and oil-measuring valves. For a single discharge, the pump handle is operated once only with a continuous downward push until the piston stops solidly against the oil in the tube, after which it is returned to its top position. If additional oil is required, the operation is repeated.

Normal Operation

Normal operation of the pump delivers oil through the tube-distributing system under an average pressure of approximately 500 lb per sq in. When the line pressure at the control, Figs. 3 and 4, reaches 75 lb per sq in., the outlet check valve in the control opens and the control piston is forced downward by pressure, thereby delivering oil to the bearing. The lower end of the piston, seating on the shoulder in the control body, acts as a cut-off valve and prevents any additional oil from being delivered to the bearing.

After all controls connected in a system have delivered oil to the bearings, release of the pump handle relieves the line pressure and permits the spring under each piston to return it to its top position. Oil meanwhile passes from above to below the piston, through the clearance between piston and cylinder, thus priming the control for the next operation. Control pistons are of three sizes to deliver respectively, 3, 11 and 22 drops per operation, Fig. 4.

Another design of hand-operated centralized lubrication system, consisting of a central pump-reservoir unit, a single-line distributing system, and an automatic control valve at each bearing, is shown in Fig. 5. The pump-reservoir unit is operated by pumping the hand lever until a pressure of 1000 lb or more is indicated on the gage. This operation develops pressure throughout the entire system to discharge all control valves at the bearings. When the hand lever is placed in

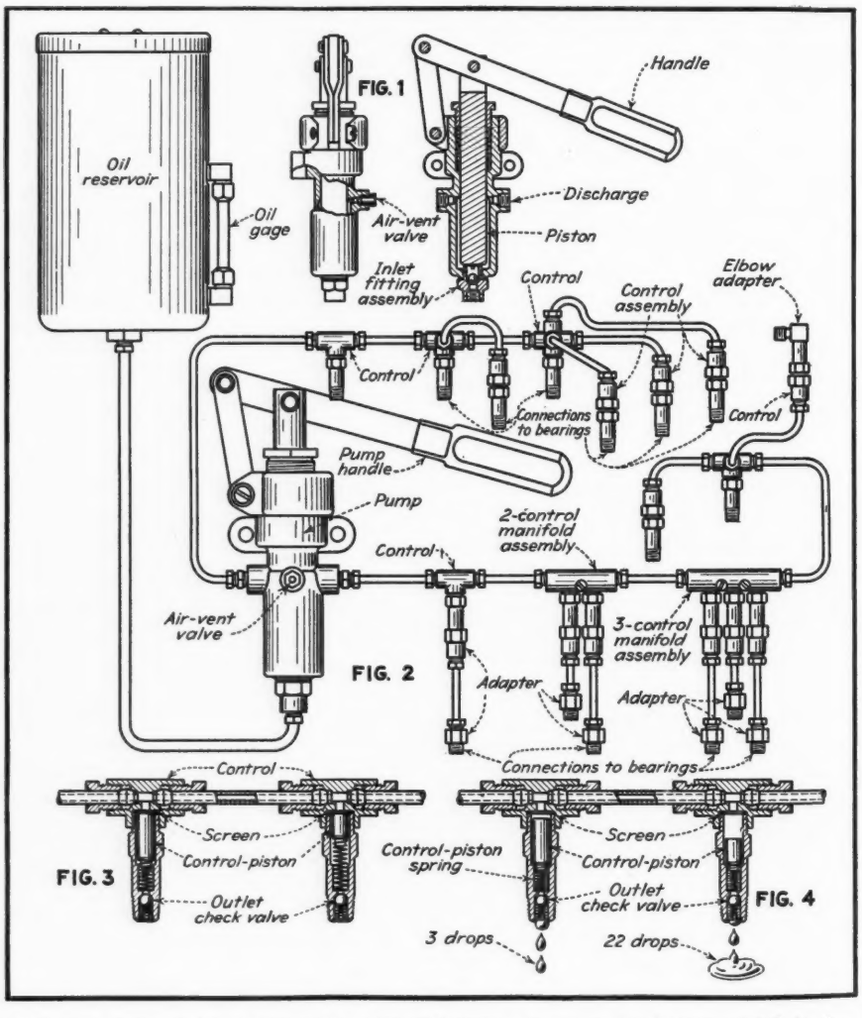
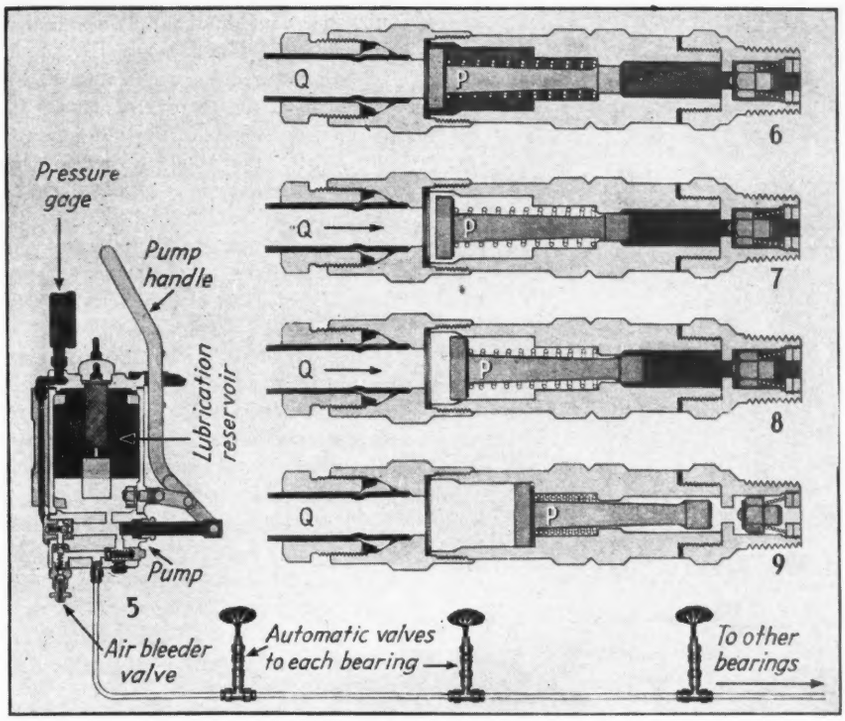


Fig. 1—Cross-section of manually operated pump for centralized pressure-lubricating system shown in Fig. 2. Figs. 3, 4—Cross sections of control valves for system, Fig. 2



Figs. 5 to 9—Cross-sections of pump and control valves for a centralized system operating on pressures up to 1000 lb sq in, indicating operation of a system

the locked position shown, pressure is relieved throughout the system and the valve refills while returning to normal position. Operation of the control valves is indicated in Figs. 5 to 9.

In Fig. 6, the valves are in normal position with no pressure on the line. In this position, piston *P* is seated against a fiber gasket closing the supply line which is always full of oil. In Fig. 7, piston *P* has been moved forward sufficiently by the pressure on the supply line to permit oil to pass around the piston, filling the valve chamber.

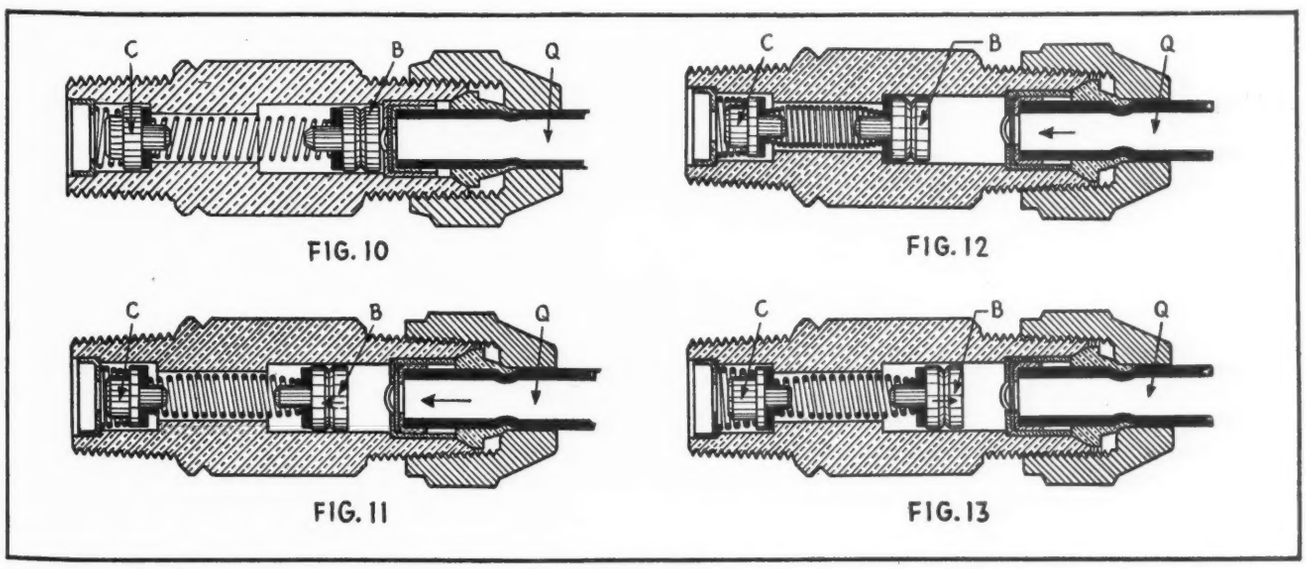
Fig. 8 shows the piston moved forward to a point where the intake is closed and the valve chamber is completely filled with oil. Inlet and outlet of the valve are both closed in this position, and the valve is loaded with a measured charge of oil, ready to be forced into the bearing. Piston *P* is closed against the valve seat in Fig. 9 and shuts off oil flow into the control valve, having discharged a measured quantity of lubricant into the bearing. When pressure is released on the line, piston *P* returns to its normal position.

This system is primarily designed for the distribution of oils, but will handle some grades of soft grease. It is manufactured in sizes to serve practically any size bearing; hence, is suitable for a wide variety of machine equipment.

Figs. 10 to 13 show sectional views of the control valves of a hand-operated system designed to handle light-bodied, pure mineral lubricating oils. It is principally intended for textile machinery, although it is suitable for any light-duty machinery requiring a light-bodied oil.

Fig. 10 shows the valve in normal position and valve chamber fully charged, but with no pressure on supply line *Q* which is always full of oil. In Fig. 11, main piston *B* is moving forward under pressure of oil in supply line *Q*. Oil ahead of piston *B* is being discharged past check valve *C* into the bearing. The valve is in the discharge position, Fig. 12, after delivery of a full charge of oil to the bearing. A fresh measured charge of oil has entered the valve chamber behind main piston *B*. Fig. 13 shows return movement of piston *B* when pressure is relieved on supply line *Q*. Oil is now flowing from the inlet chamber at the right of piston *B* to spring chamber at left. All oil has been transferred when piston *B* reaches position of Fig. 10.

Central pressure lubrication systems are also made to operate automatically. These are intended for large machines requiring a frequent supply of oil, or for a machine or a group of machines having a large number of bearings. One of these systems consists of a motor-driven pump unit controlled by an electric timer which can be set for any desired time interval. The pump is connected by a main feed line and branches to the measuring devices in much the same way as for the manually operated pump, Fig. 2.



Figs. 10 to 13—Cross-sections of the control valves for a system designed to handle light-bodied mineral lubricating oils

What is pH?

Is a solution acid or basic? Is a process being controlled to a prescribed set of conditions? These and other questions engineers answer every day, using the standard measure pH. Here is an explanation of its development and use—simple and to the point

By G A PERLEY
Leeds & Northrup Co

THE EARLY ATTEMPTS to adjust any process within certain limits of acidity or alkalinity consisted of measuring the amount of standard acid or alkali required to neutralize a given amount of a process solution. It was observed, however, that solutions of such acids as hydrochloric and acetic, which gave the same strength in a neutralization measurement, gave great variations in the resultant product when present in the same concentration in an industrial solution. This was rather conclusive proof that neutralization methods were not suitable for estimating degree of acidity.

Acids, alkalies or salts, when dissolved in water, yield ions which are atoms or groups of atoms carrying negative or positive charges of electricity. This is known as dissociation. A discussion of the origin of these charges is too involved for this article.

It is a generally accepted fact that an acid is a substance capable of supplying to its solution hydrogen bearing a positive charge, H^+, and a base is a substance capable of supplying an electronegative hydroxyl group, HO^-.

The greater the concentration of hydrogen ions, the more pronounced are the acid properties of the solution, and the greater the concentration of hydroxyl ions, the more pronounced the basic properties.

Power-plant men are interested in pH only where it affects water solutions. By general acceptance, ion concentrations are expressed in terms of "gram equivalents" per liter. An equivalent of an ion is its formula weight divided by its valence or hydrogen-replacement value. A chemically normal solution has a concentration of one gram equivalent per liter.

All acids do not dissociate, or ionize, to the same extent. Strong acids in tenth-normal concentrations, such as nitric and hydrochloric, are nearly com-

George Perley, like many men who achieve success, is modest. It was only after much persuasion that he agreed to submit a photograph of himself and a brief resumé of his experiences and accomplishments. In his letter, he hopes that we will let him off easy and not say too much, so we carry on in his own brief style.

General—Born 1886 in Goffstown, N.H. Undergraduate training in chemistry at University of New Hampshire, 1904-08. Graduate training in physical chemistry at Cornell, 1908-10. Married; one son; one daughter.

Experience—Includes teaching posts at Cornell and New Hampshire, nitrogen-fixation development with U.S. Bureau of Mines, service with U.S. Army during 1917-19 (finished up as a Major, O.R.C.), and since 1929 Chief of the Chemical Division, Research Department, Leeds & Northrup Co.

Publications—Author of 25 scientific papers and holder of 4 U.S. patents.

Society Memberships—American Chemical Society, AICE, Sigma Xi, and many others.

Hobbies—Photography (for the past 30 years—wild flowers, doorways, bridges in particular), skiing (for the past 26 years), fly fishing.

pletely dissociated; in the same concentration weak acids, such as carbonic and phosphoric, are only dissociated to a slight extent. The extent of the dissociation of any acid or base depends upon the dilution. Thus, hydrochloric acid in one-normal concentration at 77 F is 78.4% ionized, while in half normal concentrations it is 87.6% ionized. A similar situation prevails with the weak acids. The above merely indicates that for a given normality there is a much greater concentration of hydrogen ion in the hydrochloric than in the carbonic acid solution.

There are always some hydroxyl ions present, even in a very acid solution, and there are always some hydrogen ions present in an alkaline solution. An increase in either hydrogen or hydroxyl ions is compensated by a proportionate decrease in hydroxyl or hydrogen ions. A hydrogen-ion measurement is an indirect measurement of the hydroxyl ion present or visa versa.

It became evident that some method should be devised for the measurement of the hydrogen-ion concentration, if a knowledge of the effective acidity was to be attained. Not only were methods devised for obtaining this information, but a new nomenclature was adopted in order to express the hydrogen-ion concentration. Sorensen in 1909 suggested the term "pH" to indicate the logarithm of the reciprocal of the hydrogen-ion concentration. Thus, the term is expressed as

$$pH = \log \frac{1}{H^+ \text{ conc}}$$

$$\text{or } pH = -\log H^+ \text{ conc.}$$

TABLE I—APPROX. pH VALUES

Electrolyte	*H+ Conc*	*pH*
1.0 - N HCl.....	8.0×10^{-1}	0.10
0.1 - N HCl.....	8.5×10^{-2}	1.07
0.01 - N HCl.....	9.6×10^{-3}	2.02
1.0 - N Acetic Acid.	4.3×10^{-3}	2.37
0.1 - N Acetic Acid.	1.3×10^{-3}	2.87
0.01 - N Acetic Acid.	4.3×10^{-4}	3.37
1.0 - N NaOH.....	8.9×10^{-15}	14.05
0.1 - N NaOH.....	8.5×10^{-14}	13.07
0.01 - N NaOH....	7.6×10^{-13}	12.12
1.0 - N NH_4OH....	1.7×10^{-12}	11.77
0.1 - N NH_4OH....	5.4×10^{-12}	11.27
0.01 - N NH_4OH...	1.7×10^{-11}	10.77
0.1 - N H_2SO_4.....	5.9×10^{-2}	1.23
0.1 - N H_3BO_3.....	2.4×10^{-5}	4.62
0.1 - N Borax.....	6.6×10^{-10}	9.18
0.1 - N Na_2CO_3....	5.3×10^{-12}	11.28
0.1 - N $NaHCO_3$...	4.8×10^{-9}	8.32
0.1 - N Na_2HPO_4..	9.1×10^{-10}	9.04
0.1 - N Na_3PO_4....	1.1×10^{-12}	11.97

Sorensen pointed out that since the negative Briggsian logarithm of a figure such as 9.9×10^{-4} is 3.015, it is far more convenient to use the latter value. This is particularly true since there is a very great range of hydrogen-ion concentrations with which we deal. It is not convenient to indicate 0.000,000,000,000,-008,9 as the hydrogen-ion concentration of a one-normal sodium-hydroxide solution and the next moment to indicate 0.80 as the hydrogen-ion concentration of a one-normal hydrochloric-acid solution.

On the pH scale, chemically normal solutions of a strong acid will have a pH of approximately zero, the pH of pure water will be about 7, and a chemically normal solution of a strong alkali will have a pH of about 14. Thus, the working range of the pH scale lies between 0 and 14. Values below 7 pH indicate greater acidity, while values above 7 pH indicate greater alkalinity. As the concentration of an acid or a base increases above one normal, there is only a relatively small change in the degree of ionization. Thus, the limiting values are one normal acid to one normal base.

The quantities concerned in the production of acidity or alkalinity are expressed arithmetically, and it has seemed to some that it would be logical to express the intensity in a similar manner. Various types of scales have been suggested which, with our knowledge today, might appear to be superior to the Sorensen scale. However, the present scale is so firmly established that it is not easy to get universal acceptance of other proposals.

Using pH Numbers

When using pH numbers two important facts which must be remembered are as follows:

1. The greater acidity is indicated by the smaller number: Thus, a 3.65% hydrochloric-acid solution has a pH number of 0.1, while a 0.036% hydrochloric-acid solution has the higher pH number of 2.02.

2. The numbers are related logarithmically and not arithmetically. Thus, a hydrogen-ion concentration of 6×10^{-4} is twice that of 3×10^{-4}, yet the respective pH values are 3.22 pH and 3.52 pH.

We associate sour taste with acidity and the more sour a solution the greater is the acidity. We might illustrate the relationship of pH to acidity by the fact that orange juice with a pH number of 3.6 is approximately eight times as sour as grape juice with a pH number of 4.5.

It is readily apparent that the relation between pH and H^+ conc. is not linear or proportional. Each unit of increase in the pH number corresponds to a diminution in hydrogen-ion concentration to one-tenth of that concentration indicated by the preceding pH number.

Table 1 gives approximate pH values of various aqueous solutions in common use.

There is one feature involved in a discussion of pH that should not be neglected, although it has no connection with the definition of pH. The hydrogen-ion concentration of most solutions varies with the temperature, hence, the pH of the same solution at a temperature of 180 F will probably be appreciably different from that at 77 F. This point may be illustrated to advantage in the case of pure water. The influence of temperature upon the ionization of water is such that pure water has the following pH values at various temperatures:

Temp.		*pH*
32 F	(0 C)	7.47
60.8 F	(16 C)	7.10
71.6 F	(22 C)	7.00
86.0 F	(30 C)	6.86
104.0 F	(40 C)	6.71
212.0 F	(100 C)	6.12

Hence, a truly neutral solution at a given temperature will have the corresponding pH value as indicated in the temp/pH table.

Process Temperature

It is desirable to make a pH measurement of a solution at the temperature of the process rather than at some other temperature, since the temperature coefficients for most industrial solutions are not known. To illustrate this point, a shaving cream might be tested in the laboratory to give exactly a 7.0 pH value at a room temperature of 71.6 F, yet when warmed to skin temperature of about 98.6 F the pH value might be something different, and the difference is not known except after making experimental studies. Then, too, 6.75 pH is the neutral point at 98.6 F.

In the practical application the chemical laboratory establishes the most desirable hydrogen-ion concentration for a given process and determines the limits over which a variation may be acceptable. The corresponding pH variation then fixes the conditions for operation. A knowledge of the relative pH values is essentially all that is required by the operator for an understanding of whether a given process is being controlled to a prescribed set of conditions.

Accumulators—What They Are,

Modern heat-storage equipment offers many possibilities for solving peak-load problems. Here are basic data on leading accumulators and hookups for applying them

By MAX F A WULFINGHOFF

IN MOST PLANTS, steam demand varies within wide limits depending on a great number of more or less uncontrollable factors. While in many cases individual load changes may cancel out, there is an equal chance for simultaneous piling up of the different items of load. With no special provision for covering load peaks, each individual part of the power-generating setup, including all auxiliaries, must be laid out to suit the maximum load. This increases both first cost and operating cost.

One solution to the peak problem, which may prove economically justified in certain cases, is storing energy in one form or another. According to the different states of heat present (heat in fuel, heat in steam, and, eventually, heat in electrical energy), corresponding possibilities for storage exist. Since all equipment between point of storage and point of final energy use must be large enough to handle maximum loads, it is highly desirable to store energy as near its final form as possible. Storing electricity is nearly always uneconomic, so usual storage systems work with steam or water, before conversion.

Another solution to the peak problem has been proposed—to design plants to operate at widely variable pressures (Siemens variable-pressure process). In a setup consisting of, say a boiler and turbine-generator, steam pressure can be made to follow the load, if the fuel and feedwater supply are controlled accordingly. However, to safeguard efficient functioning of the auxiliaries over the entire possible load range, it has been found necessary to

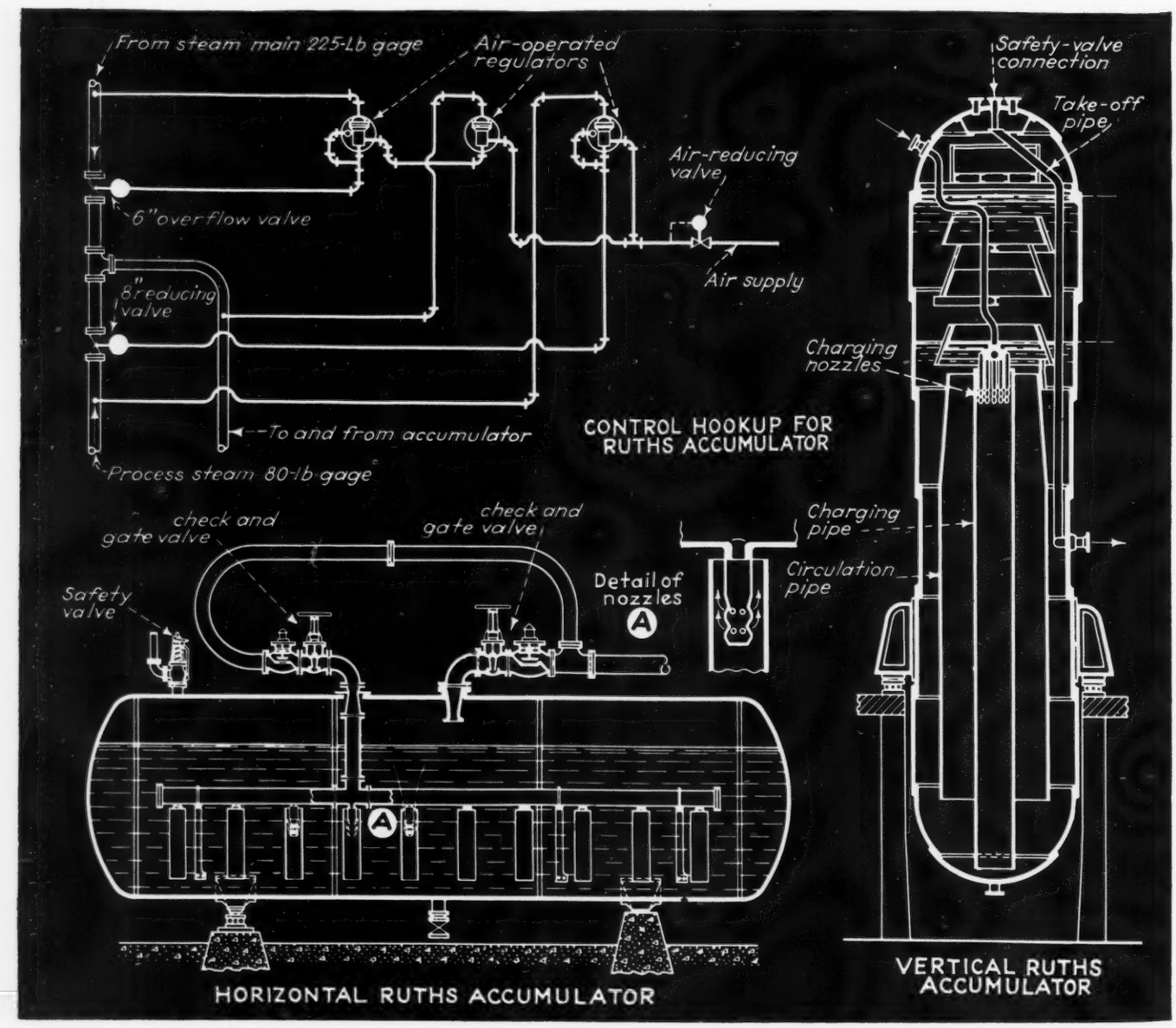


Fig. 1—Two designs of variable-pressure accumulators and a typical control diagram

What They Do

provide two feed pumps, one for the "normal" and one for the "upper" range. These are coupled to a variable-pressure turbine which also drives an alternator supplying energy to variable-speed auxiliaries, such as fans. Necessary adjusting of feed and fuel takes up a certain amount of time so that installations of this type must be run on a more or less definite schedule. First cost of such plants is considerable, as they must be designed for max. working pressure and since at least some auxiliaries must be duplicated.

Thus, in most cases, overcoming peak problems depends on providing a "thermal cushion" between the steam producer and the steam-using equipment. This is an obvious middle course, permitting operation under steady firing conditions, hence, at best boiler and furnace efficiency. Accumulators also work to advantage with waste-heat boilers where rate of steam generation depends on heat available rather than steam demand. Storage will take care of excess steam and prevent losses through popping of safety valves.

Steam-storage devices are usually called accumulators. Table I gives principal characteristics of modern storage equipment.

Most successful in the first group is the Ruths variable-pressure design. These accumulators consist of horizontal or vertical cylindrical reservoirs, with elliptical or hemispherical ends, filled with water up to 90–95% of capacity (Fig. 1). They have been built for pressure ranges of 250 lb to 15-in. Hg abs, and up to tank volumes of 12,500 cu ft. As much as 425 cu ft of steam can be liberated per sq ft of water surface. The mass of water in the tank must, of course, be sufficient to give off the weight of steam desired during the discharge period, with a predetermined drop in pressure. Fig. 2 shows the steam-storage capacity of water under pressure.

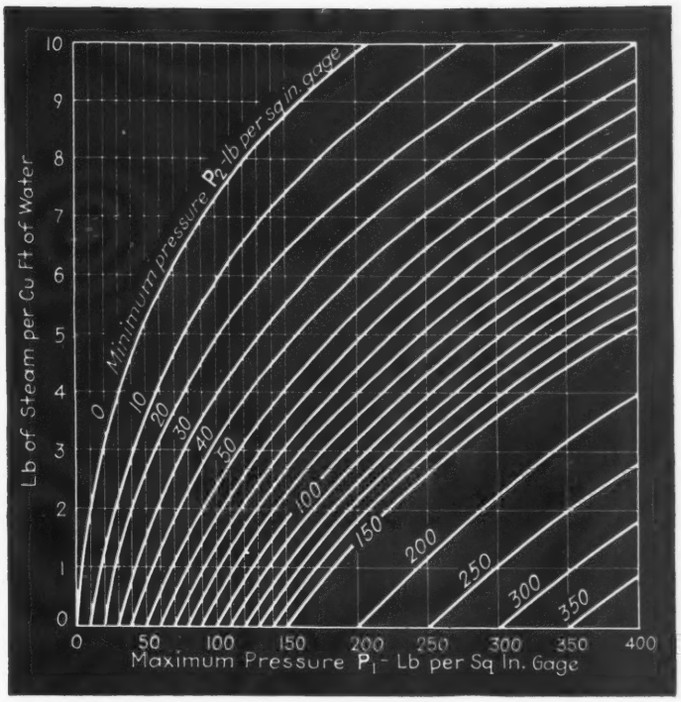


Fig. 2—Steam-storage capacity of water

Live steam enters through charging nozzles immediately below the water line, thus avoiding unnecessary back-pressure of the water column. Baffles make the water circulate and promote more uniform temperature distribution and, consequently, stress distribution in the shell. Suitable lagging reduces heat losses. Since most accumulators are installed outdoors, protection against external moisture is usually provided. A temperature drop, under constant conditions, of 5-F per 24 hours is usually considered reasonable.

When discharged, the accumulator is under low pressure. Any steam not needed in the plant flows in and is condensed in the mass of water with a consequent building up of temperature and pressure. A completely charged accumulator contains water at its boiling point under maximum operating pressure. When the discharge valve opens, pressure goes down, and it falls throughout the entire discharge period. This pressure drop causes liberation of latent heat and water flashes to steam. While the steam supplied may be superheated, the steam from the accumulator is practically saturated. This feature permits employing the accumulator as a desuperheater. However, since steam of inferior heat content is withdrawn as compared to the steam supplied, the quantity of the former must be greater than the latter. Therefore, water in the tank decreases and must be replenished occasionally.

TABLE I — TYPES AND APPLICATIONS OF ACCUMULATORS

Load conditions	*Accumulator type*	*Pressure range*	*Pressure at prime mover*	*Pressure in accumulator*	*Typical applications*
Sudden, short fluctuations	Low-pressure	Below blr pressure, up to abt 250 lb	Variable	Variable	Process plants, pulp and paper mills, etc
Few, irregular, extreme peaks	High-pressure	Above blr press, not limited	Constant, equal to blr press	Variable, above blr press	Central stations
Regular fluctuations of extended duration	Feedwater	Equal to boiler pressure	Constant, equal to blr press	Constant, equal to blr press	Rolling mills, forge shops, etc

"Accumulator" Turbines

While an accumulator will considerably relieve the steam-generating plant, prime-movers are required to handle the peak load in any case—accumulator or no accumulator. For use with accumulators, special turbines to operate at variable pressure have been developed. Their efficiency is, however, comparatively low, because for best operating efficiency, prime-mover throttle pressure must be kept constant. During the discharge period, steam volume increases considerably, so fresh turbine elements with liberal passages must be

added consecutively. Because it may be difficult to get the ultimately large steam volume through the low-pressure stage of the turbine, double- or multi-flow designs must often be employed. Thermal efficiency of power generation in an accumulator and variable-pressure turbine installation may be only half that of a modern standard plant, due to transformation losses and lower efficiency of the accumulator turbine.

Mixed-Pressure Turbines

Mixed-pressure turbines for boiler and accumulator steam depend, during moderate loads, on direct live steam only, while during peak loads, storage steam is admitted through auxiliary valves. The controls incorporate two sets of valves, one for direct steam and one for accumulator steam. Both are interconnected by a leverage system to which are attached speed governor, boiler-pressure control, accumulator-pressure control, and limit control. Whenever the difference in pressure between accumulator and first turbine stage becomes too small, the limit control prevents steam from flowing back from turbine to accumulator. As steam reserve in the accumulator diminishes, the pressure becomes less and less. To prevent turbine output from dropping, the accumulator-pressure control opens the discharging valve until the limit has been reached when the live-steam control switches over to direct steam operation again. The speed governor can at any time shut down both steam controls.

If desired, it is also possible to extract, during moderate loads, steam from the auxiliary valves. When charging the accumulator, extraction steam of the lowest possible pressure is used in the first place; later on a higher pressure is admitted, etc, until finally live steam is introduced.

Thus the turbine extraction points may have three different uses: admitting storage steam to the turbine during peak times, charging the accumulator with low-pressure steam, and supplying extraction steam for feedheating in the usual way. This produces excellent thermal economy; however, the plant becomes rather intricate and investment cost increases.

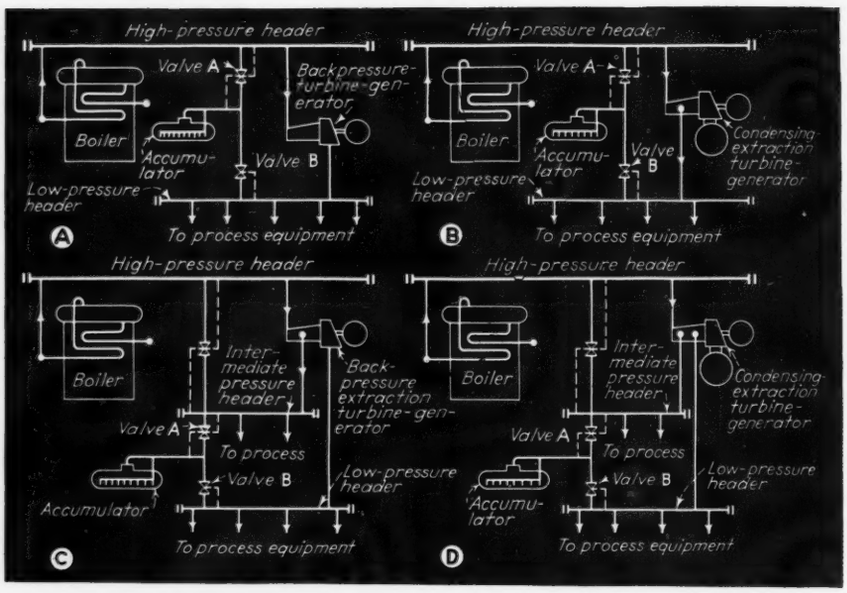


Fig. 3—Variable-pressure accumulator in power-process hookups: A and C represent plants where process demand exceeds power demand, B and D plants where the reverse is true. On the other hand, A and B are plants with only one process pressure, while C and D have two process-pressure levels

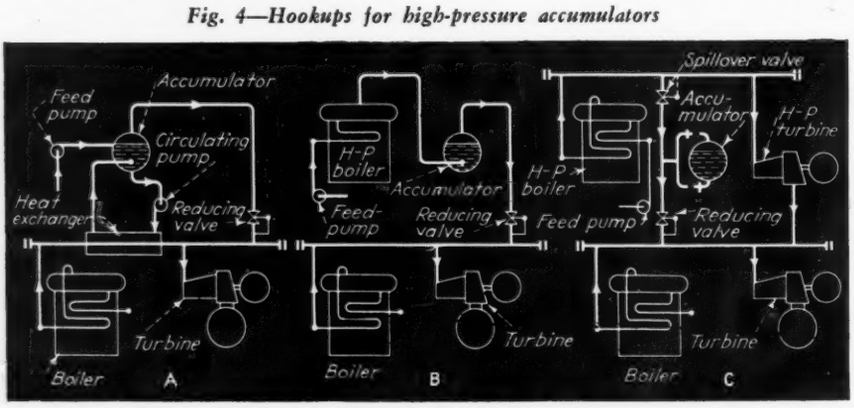
In cases where an accumulator turbine is meant as an instantaneous standby, that is, where unexpected peaks must be got over, the unit may be kept running, receiving its impulse from the electric side and working as a phase shifter. With this type of operation, a small amount of steam to the turbine serves to maintain condenser vacuum and to cool turbine blading.

When an accumulator is considered in connection with a backpressure prime-mover and a heating or processing plant, and with a power demand out of exact proportion to the demand for low-pressure steam, different possibilities exist. R Boese and F Beuthner give fundamental hookups in Fig. 3; which is used for a given job depends on the relative importance of power and heat demand. In all cases, the accumulator only takes care of temporary unbalances in relative steam and power loads. Where the average process and power loads are out of balance, this unbalance must be taken care of by other means. Case *A* shows use of an accumulator with a back-pressure turbine serving a plant where process demand exceeds, on the average, the power demand. With an excess in power load (too much low-pressure steam available) a condenser would be needed to avoid feedwater losses (B).

If a processing plant requires steam at two different pressures, an accumulator between two pressure stages may be advantageous (Cases *C* and *D*). Where moreover, a back-pressure prime-mover is connected to the higher pressure, an accumulator can in itself balance the variations in low-pressure steam volume from this engine as well as the variations in the ratio between high- and low-pressure steam use.

Accumulators of the second group in the table are somewhat more intricate in function and require heavier drums, but they offer the important advantage of having a minimum discharge pressure corresponding to turbine throttle pressure and so it is unnecessary to resort to special turbines. Fig. 4 shows different hookups as given in a recent paper by L Musil. Existing boilers may be fitted with additional superheating surface, and the heat equivalent of the superheat is then transferred by a heat exchanger from the live boiler steam to the mass of water in the storage tanks (A). Where the necessary superheating surface cannot be provided in the existing steam producers, a special high-pressure boiler for charging the

Fig. 4—Hookups for high-pressure accumulators



accumulator is provided. The advantage of this arrangement, as compared to the previous one, is that the charging process requires less time (B). Finally, the accumulator may be charged from a high-pressure boiler directly, and feed the low-pressure turbine through a reducing valve (C).

Feedwater Accumulators

The third accumulator group includes constant-pressure systems which store hot water under pressure. These so called "feedwater" accumulators are installed ahead of the boiler plant, and at peak times they deliver hot water to the boilers, the water temperature being considerably higher than the feed temperature at average load. The size of an accumulator of this type is found from the total steam volume that must be generated during peak time. The storage volume should correspond to the total steam weight converted into hot water, allowing some latitude to provide for all contingencies. At times of less than average load, extraction steam can be drawn from a turbine to heat the mass of water. Excess live steam from the boiler, when lightly loaded, serves to bring the storage-water temperature up to the desired level. In many cases, heating steam is introduced into the water directly. Thus the storage-water temperature may become substantially equal to the saturation temperature at boiler pressure. Then the boiler at peak times has only to supply the latent heat of vaporization and superheat, while the heat in the feedwater up to the evaporation temperature is provided by the accumulator, as long as the pressure in the latter is no less than that in the boiler.

The external appearance of this type of accumulator is much like that of a low-pressure storage system. With boilers operating at high pressures, thick plates would be required in the tank, the size of which can be reduced either by providing several smaller drums instead of one large tank, or by keeping the accumulator contents at a lower pressure and temperature. The pressure difference with respect to the boiler can be overcome by a pump.

Kiesselbach Accumulator

The Kiesselbach accumulator is a constant-pressure system in which the storage space is in immediate contact with the boiler water and steam spaces. The general arrangement is shown in Fig. 5A. Boiler drum *b* and accumulator tank *a* are connected by circulating pipe *c* and overflow pipe *o*. Pump *p* maintains a continuous circulation. Pipe *e* equalizes the pressures in *a* and

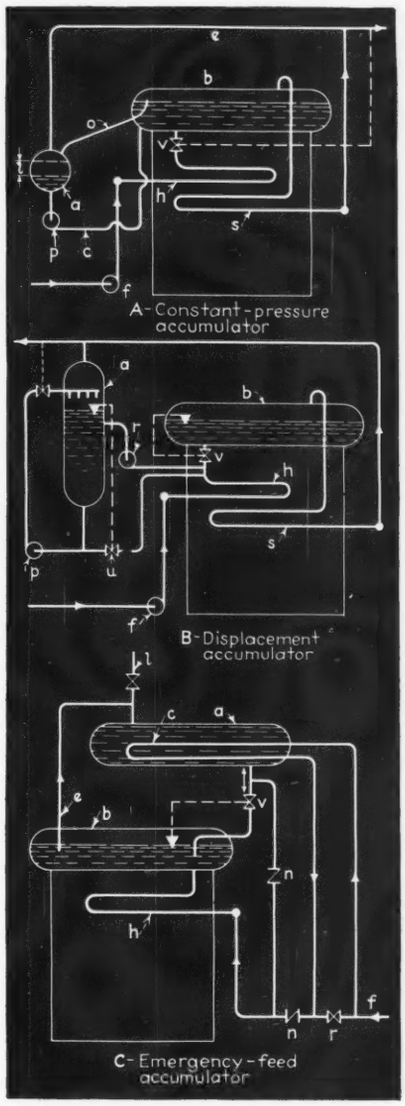


Fig. 5—Three types of "feedwater" accumulators in present use

b. With decreasing steam demand, the pressure in the steam main rises, valve *v* opens, and fresh feed is supplied to the boiler by feed pump *f* via economizer *h*. This makes the water level in *b* rise, which causes the excess hot water to flow through *o* to *a*. When the steam demand increases, the supply of fresh feed is reduced and pump *p* delivers hot water at boiler pressure from *a*, a volume corresponding to the difference *l* in water levels being available for this. The superheater is shown at *s*. The operating effect of this accumulator is, of course, that of an enlargement of useful boiler capacity.

Displacement accumulators, Fig. 5B, of which the Christians type is perhaps the best known, collect excess hot water from the economizer, which becomes available with high gas temperature and a less-than-normal feedwater demand. Thus steam formation in the economizer is prevented, and a heat reserve is provided. Referring to the figure, economizer *h* runs in the usual fashion, and the excess in heated water is pumped into accumulator tank *a*. The output of feedpump *f* is kept constant as long as the water content of *a* can be varied. If a definite volume of water must be maintained in *a*, the output of *f* is governed accordingly. The water supplied to *a* by means of circulating pump *p* is heated in contact with the boiler steam entering on top. Pump *r* feeds hot water into boiler drum *b* through valve *v*. Valves *u* and *v* open automatically when the water level in the corresponding spaces becomes lower. The superheater is marked *s*. A disadvantage of this arrangement is that the accumulator shell comes successively into contact with hot and cold water, which condition may cause thermal strains and leakage.

Emergency Feed

Continuous supply of feedwater to a boiler becomes more important as its water content gets smaller. If water supply is interrupted, it would be difficult to keep some types of modern water-tube boilers in operation for more than a few minutes. To provide for similar emergencies, a displacement accumulator may be so connected with a boiler as to take care of the feed supply for a sufficient interval, flow of the water reserve to the boiler drum being assured by gravity.

A suitable hookup developed by the Borsig Co is explained in Fig. 5C. Accumulator tank *a* is connected to boiler drum *b* by water line *w* and equalizing pipe *e*. The lower end of *e* is at the level corresponding to the minimum admissible water capacity; *l* is an air expelling valve. A cooling coil *c* is inserted into the path of the feedwater; its purpose is to prevent formation of steam in the storage tank. The quantity of water passing through this coil can be regulated by means of valve *r*.

The feedwater line from the pumps is marked *f*, and *v* is the regular feedwater regulating valve. While the end of the pipe *e* stays submerged, that is, as long as feed pumps function properly, there is only a slight natural circulation of hot water. When however, the water level in *b* goes down, some steam enters line *e*, making a corresponding volume of water flow to *b* by gravity.

The two check valves *n* insure a sufficient supply of water to the economizer at all times to prevent over-heating and burning. The volume of water in the tank is usually so selected that steam production can be maintained for 15 to 30 minutes regardless of an interruption in the feedwater supply.

Fuel Engineers Find a New Tool

Display of furnace "movies" at ASME and AIMME joint meeting demonstrates progress in studying mechanism of combustion. Other papers cover burning of anthracite, proposed fuel-test code, and properties of coal-ash slags

COLUMBUS, OHIO, OCT 7—Fuel engineers and coal producers pooled their knowledge of this country's No. 1 fuel at the third joint meeting of the Fuels Division, ASME and the Coal Division, AIMME held here, Oct 5–7. The result was a series of papers on utilization of coal for power generation and industrial purposes, on basic properties of coal, and on the effect of production methods on coal cost and characteristics.

During the past year, use of the motion-picture camera for studying combustion has developed by leaps and bounds, and an extensive demonstration of its possibilities climaxed the technical sessions of this meeting. A A Markson and W H Dargan, Consolidated Edison Co of N. Y., led off by describing, in some detail, methods they have developed in more than a year's study of furnace photography. Where only short exposure to intense furnace heat is necessary, any standard "movie" camera may be used, but for many kinds of work they found it advisable to add a "pyroscope" to their equipment. This device is really two telescopes placed end to end in a water-cooled tube, Fig. 1. Its only job is to keep the camera away from furnace heat and to permit taking pictures through small openings in the boiler. No magnification is involved.

Running the camera at varying speeds gives many special effects. Thus, for studying motion in a stoker fuel bed, taking pictures at 3-sec intervals and projecting them at standard speed (16 per sec) speeds up the slow progress of the fuel and makes feeding action and agitation clearly visible. On the other hand, speeding up the rate of taking pictures gives the familiar "slow-motion" effect, extremely useful for watching flame travel in pulverized-coal furnaces. Many standard cameras give a wide range of speeds, and the authors recently acquired a special camera that will take as many as 2500 pictures per second.

Considering in turn the various factors such as emulsion speed, exposure time, use of filters, sensitivity to light of different wavelengths, the authors gave an illuminating discussion of the numerous technical details involved in making pictures that will display desired characteristics. By way of illustrating their experiments, they ran off several reels of shots made in their company's plants. These showed use of high-speed and slow-speed picture making, and black-and-white, Kodachrome, and infra-red film, on both stoker and pulverized-coal fires.

Discussion of the paper took the form of a showing of other films made by experimenters in other parts of the country. Otto de Lorenzi, Combustion Engineering Co, displayed reels showing slag formation, flame travel, and slag tapping in a 750,000-lb-per-hr pulverized-coal boiler at Windsor Station. These pictures were made with a standard camera and from regular furnace and boiler openings. To get pictures of the action of a small domestic stoker, S Konzo, Engineering Experiment Station, University of Illinois, replaced a firing door with a Pyrex glass shield and shot his scenes through that. Amount of illumination was no problem in the large furnaces, due to their extreme brightness, but it was necessary on this smaller fire to use two photoflood lamps to light the furnace around the fire, particularly when the fire burned low during the "off" cycle of the intermittently-operated stoker. These pictures showed graphically the entire cycle of intermittent burning, from the low fire at the end of an "off" period, through the beginning of stoker operation, full operation, and shutdown.

Some striking pictures, taken with a standard camera and no auxiliary devices of any kind, proved that effective work can be done with the simplest equipment if care is taken not to expose the camera to furnace heat for more than a few minutes at a time. Taken by G C Campbell, Sinclair Refining Co, these shots were made in a wide range of plants burning gas and oil and clearly showed the action of different types of burners in furnaces of varying shape and demonstrated the

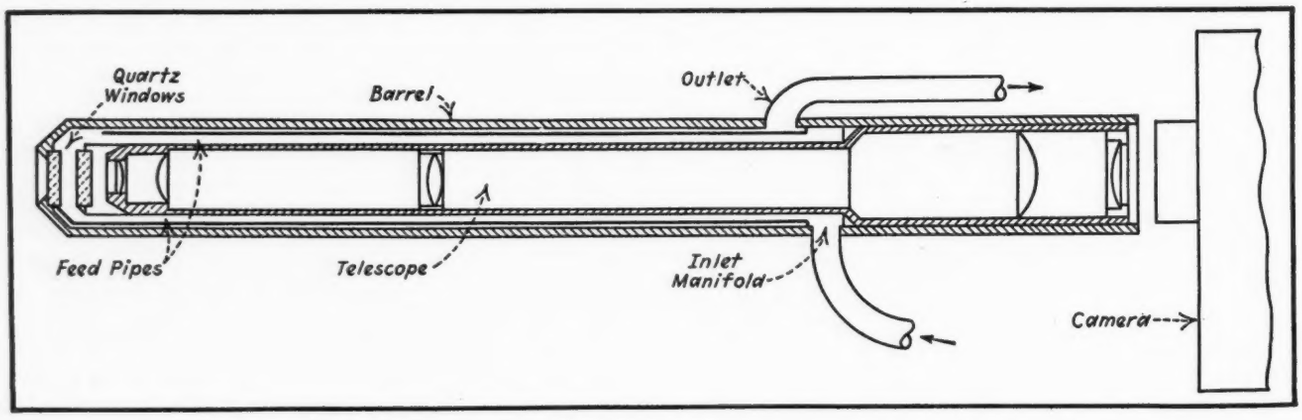


Fig. 1—This "pyroscope", a water-cooled double-telescope, allows camera to be kept back from furnace heat

importance of proper mixing of fuel and air.

Many industrial plants burn anthracite, using the small sizes produced as a byproduct of the larger domestic sizes, and several types of firing equipment can be utilized. William Lloyd, Combustion Engineering Co, in his paper "Industrial Firing of Anthracite," listed the following: forced-draft chain-and-bar traveling-grate stokers, single-retort underfeed stokers, spreader stokers, and pulverized-coal furnaces. The first are most widely used for boilers of 2000 sq ft and up.

To assist and sustain ignition of the low-volatile anthracite, early furnaces used a front arch. This shaded the incoming green fuel from the radiant-heat-absorbing surfaces of the boiler and also radiated heat back to the green fuel. Trouble resulted because air pressure needed for complete combustion of gases above the fuel bed caused excessive carbon loss. Development of the combination front-and-rear arch furnace in the early 1920's helped by keeping the ignition features of the front arch and by cutting ash-pit loss.

More recently the trend has been to furnaces with long rear arches, Fig. 2, and no front arch to speak of. The rear arch directs gases from rear to front, establishing ignition and speeding up combustion. With this development came improved methods of air distribution over the length of the grate. This furnace design offers higher combustion rates, lower losses and more flexibility.

Use of pulverized anthracite is confined largely to districts where quantities of anthracite silt are available at low-cost. Modern units usually use direct firing into water-cooled furnaces, with preheated air of relatively high temperature. The ball-mill pulverizer has generally been found most suitable. The most practical method of burning involves vertical firing, with long flame travel and a much richer mixture at the burners than with bituminous coal.

The ability of spreader stokers to burn smaller sizes without pulverizing and the wide range of emergency fuels that they can handle seemed to indicate to Mr Lloyd that further development could greatly enlarge their use in anthracite burning. Single-retort underfeed stokers have been developed to burn all but the very small sizes of anthracite, under small boilers.

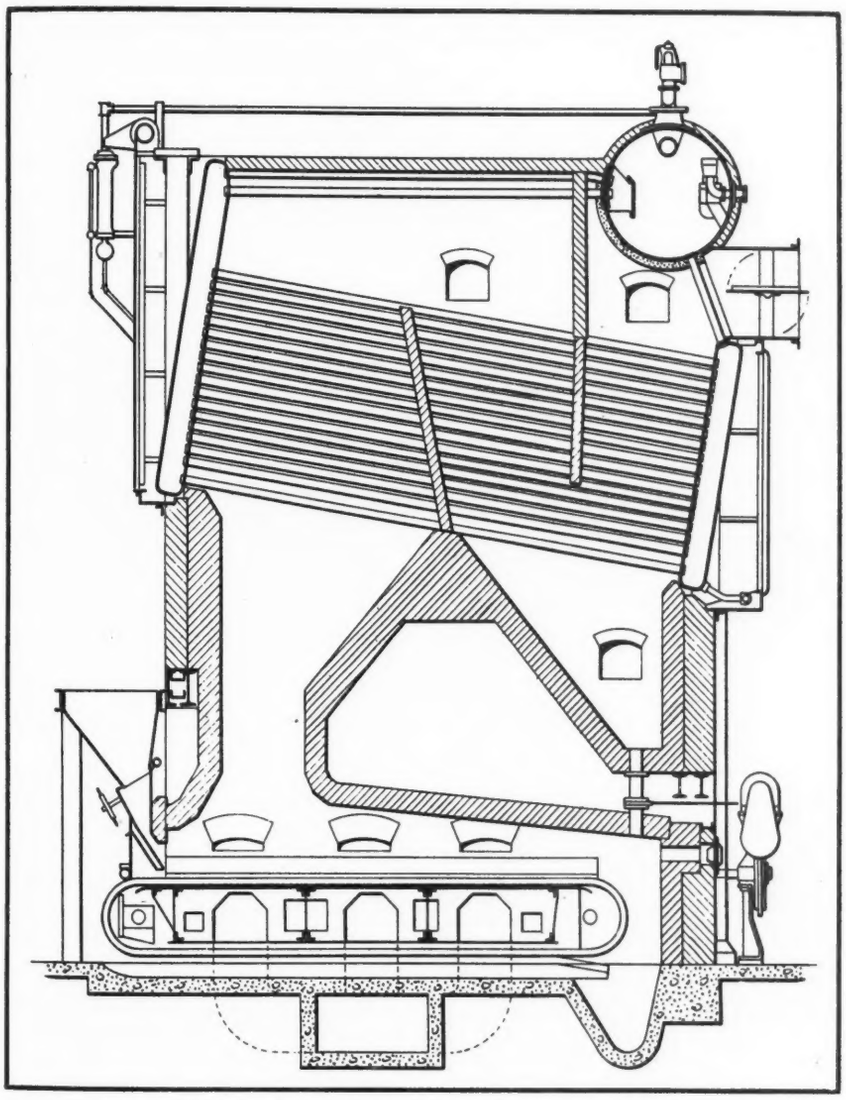


Fig. 2—Modern furnace for burning anthracite on traveling-grates

The need for a code or codes to cover the testing of combustion of fuels in various types of burning equipment was pointed out by R L Rowan, General Coal Co, who proposed that a joint committee of the ASME and AIMME be appointed to study the matter. Mr Rowan pointed out that the present ASME test codes, while entirely adequate for their purpose, are primarily aimed at determining equipment efficiency. If fuel-test codes could be devised, valuable data would become available which might be correlated with laboratory tests and analyses so that operators and designers could tell beforehand how a given coal would behave with certain types of equipment. Consensus of opinion was that efforts to develop such a code, while requiring long and painstaking work, would be productive and a joint committee was appointed.

T R Workman, West Virginia Coal and Coke Corp, spoke on "Coordination of Fuel Engineering from the Mine to the Consumer." He outlined a scheme of organization and showed the gains to both producer and consumer resulting from such a plan.

Slag Viscosity

Contributing to the growing sum of knowledge on the basic properties of coal, P Nicholls and W T Reid, Bureau of Mines, reported on an investigation of the viscosity of coal-ash slags. In a special viscosimeter suitable for measurements at temperatures up to 2900 F, slags of varying composition were studied, to clear up some of the fog surrounding the fusion characteristics of coal-ash slags. When additional data is available, it will be possible to predict the effect of mixing the ash of two coals or of the addition of the main constituents. Further study will shed light on the relative fusion and clinkering characteristics of coals, important factors in furnace operation.

Other papers included A Symposium on Effect of Mining Methods on Coal Characteristics. Also: "The Use of Pulverized Coal as Fuel for Open-Hearth Furnaces Melting Steel for Castings" by J P Kittredge; "The Measurement of Pressures Developed during the Carbonization of Coal" by C C Russell; "Coal and Gas" by A M Beebee.

Adjusting Feed-Pump Speed Saves Power Over Throttling

Tests show that wound-rotor motor driving feed pump cuts power costs over unit designed for constant speed with output controlled by throttling

By A E BEARDMORE, *General Electric Co*

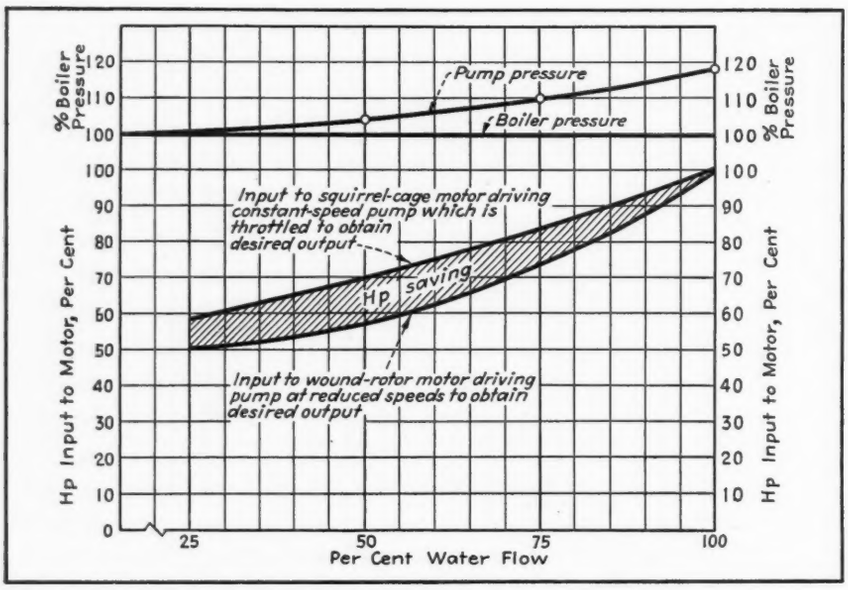


Fig. 1—Cross-hatched area shows estimated power saving from wound-rotor motor

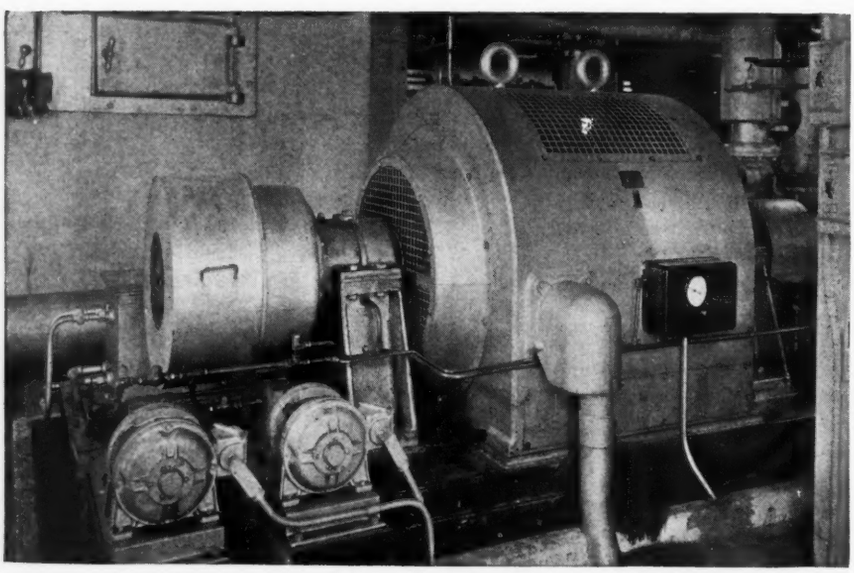


Fig. 2—800-hp, 3600-rpm, wound-rotor induction motor coupled to boiler-feed pump

RATE OF FLOW of boiler feedwater can be controlled (1) by throttling the pump or (2) by adjusting pump speed. In the first case, result is an increase of pressure in the hydraulic system from the excess-pressure valve back into the pump. This increases the pressure drop across the excess-pressure valve, producing more valve wear and power loss in the pump.

Maximum pressure will occur at minimum flow and may be 130% of that needed to supply water to the boiler. In some cases, because of this excess pressure, more expensive piping has to be used than if pressure is reduced by adjusting pump speed to meet operating conditions.

If an adjustable-speed, wound-rotor motor drives a feed pump, its speed can be controlled by a differential-pressure regulator. This device maintains the proper pressure drop across the water-level regulating valve, permitting it to operate smoothly and to control water level accurately. Operating at reduced speed and pressure decreases the losses in the hydraulic system and consequently, the power required to drive the pump. This saving is most important where it is necessary to keep the boiler on the line at reduced loads for long periods of time.

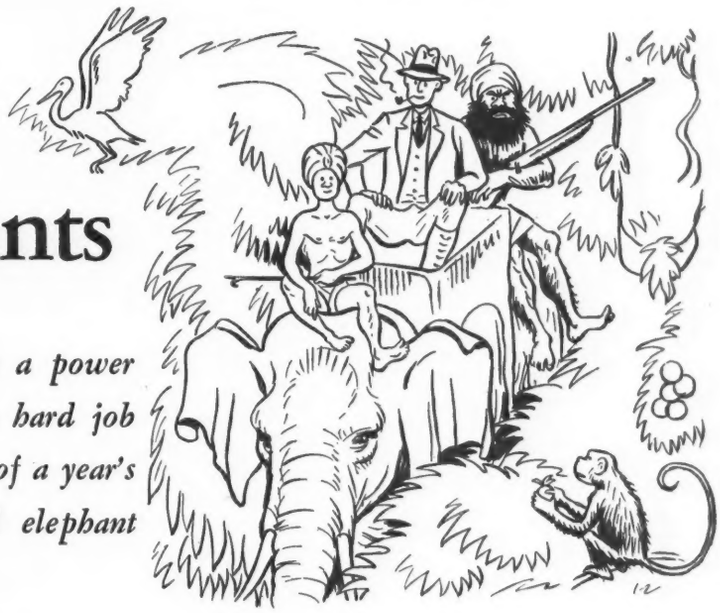
Secondary control of a wound-rotor motor driving a boiler-feed pump is usually arranged to return automatically to the low-speed position in case of a serious reduction in, or total loss of, voltage. Then, when power returns, the motor will restart immediately, without any attention on the part of the operator. This is an important feature in time of trouble. When the motor restarts, it accelerates smoothly to the operating speed called for by the differential-pressure control. Thus, excessive surges in the power system and hydraulic surges in the feedwater system are avoided.

The curves, Fig. 1, compare estimated horsepower inputs to a constant-speed and to an adjustable-speed pump. A squirrel-cage motor drives the constant-speed pump which is throttled to

control flow to the boiler. The adjustable-speed pump is driven by a wound-rotor motor, speed of which is adjusted according to water flow required to the boiler. The curve, "pump pressure," shows the pressure necessary to supply water to the boiler.

These curves are taken from data submitted by a reliable pump manufacturer for a proposed large high-pressure installation. One pump was designed specifically for operation at constant speed with the output controlled by throttling, while the other pump was designed for operation at different speeds to control the flow to the boiler. Both are high-speed pumps designed for use with the same boiler and represent the most favorable characteristics which the pump manufacturer offered. They, therefore, make an excellent comparison of the power consumption of the two methods of drive for the job in question.

A saving in power is obtained at any point below maximum capacity, Fig. 1. This saving is greatest over the range between 30 and 75% water flow. In this range the saving is as much as 10 to 13% of the power required to drive the pump at full speed. Fig. 2 shows an adjustable-speed, wound-rotor, 800-hp, 3600-rpm motor driving a high-pressure centrifugal boiler-feed pump. This is one of the largest 3600-rpm wound-rotor motors ever built.



Riding Elephants

An American erecting engineer installs a power plant for an Oriental potentate. For a hard job well done, he is rewarded with a bonus of a year's salary and a wild ride on the royal elephant

By N L REA, *General Electric Co*

ONCE UPON A TIME—not so many years ago—an Eastern potentate ordered a complete power plant consisting of penstocks, waterwheels, generators, switching equipment, transmission-line material, step-down transformers, secondary distribution, street lights and palace lighting equipment. In due time, an electrical erecting engineer was requested. Detailed specifications accompanied this order. First of all, he must have great skill in his profession. Equally important, he must be of excellent character and morals, able to get along with people and handle men of a proud, warlike race. He also must be single, as no white woman would be admitted to that country.

A detailed recommendation was submitted, and, after several months, a definite order for the erecting engineer was received. This also gave detailed instructions. The engineer was to report to His Royal Highness' agents, at a far-away seaport, on or about a certain date. These agents would give him detailed instructions, provide him with all that was necessary, and escort him to the end of the railway in the high hills. There, he would be met by an escort that would take him to the capital city and the Royal Presence.

Meanwhile, I had to talk "turkey" to the selected engineer to overcome a bad case of cold pedal extremities. Ignorant but well-meaning friends had sympathized, condoled and said their last goodbyes.

"You are going to a wild, warlike and heathen country, where anything can, and probably will, happen."

"A white man's graveyard," etc., etc. . . . .

He was told, "Don't be a 'dashed' fool! This power system is the latest and dearest project of His Royal Highness. You, therefore, will be carefully guarded and protected at all times. Furthermore, remember, this was a 'going' and cultured country when these United States were a howling wilderness. Their ways are not our ways, but who knows if ours are best?"

Convinced, but not converted, the engineer said farewell and departed.

Weeks later, he was met at the boat by His Royal Highness' representatives, entertained, outfitted and escorted by two men to railhead. There, these guides, who spoke excellent English, delivered him and his baggage to an escort, saying, we are not permitted to go farther with you, but the man in command of your escort is most excellent and will bring you safely to His Royal Highness. True, he does not speak or understand any English, but you will be quite safe and will, we hope, have a comfortable journey."

The aforesaid escort consisted of a bullock cart, a number of men, and last, but by no means least, the leader. He was a big, bearded, fierce-looking hillman, armed with an assortment of wicked knives, a gold-plated rifle, and with two bandoleers of cartridges draped crossways on his broad chest.

The baggage having been loaded in

the bullock cart, a large pile of cushions was arranged, and the engineer invited, by signs, to get in. The "Chief" then seated himself cross-legged in the rear of the cart and "barked" the marching orders.

At noon, they halted, spread an elaborate picnic lunch and then, "Forward again," and all the time the Chief never took his fierce gaze off the engineer, nor let him get beyond reaching distance. This was so marked that nervousness grew to fear that bodily injury, if not murder, was intended.

Near nightfall, they halted at a rest house, where food and a room were prepared and the engineer informed, by signs, that they would spend the night and proceed on their journey the next morning. By this time, the fierce watchfulness had the engineer's "wind up"; —so much so that he stepped quickly into his room and closed the door, thinking, "He may go away after a while and give me a little peace and privacy." No luck, however! For, when he tried to cautiously open the door some time later, he found the Chief stretched on the door mat.

Too Risky for Walking

Nothing happened during the night, and, early the next forenoon, they reached the end of the cart road. Ahead was a drop of several thousand feet over smooth rock, where footholes had been cut and polished by centuries of use. A chair, fitted with three sets of iron stirrups, so that it could be mounted on carrying poles for downhill level, or uphill travel, did not look at all good. It was not comfortable to look down over the bearers' heads for one-half a mile or more and wonder what would happen if someone stumbled or slipped. The engineer thought of walking. However, the steps were several inches longer than our stairs and far too smooth for shoes. So, the chair had to be used.

At the foot of the mountain was a Royal elephant for the balance of the journey to the capital. Here, he was met by an Englishman, who made all arrangements for a Royal Audience.

Almost the first question the engineer asked was, "Has the Chief of my escort a grudge against white men in general or me in paritcular? I have expected him to jump me almost any minute for the past two days!"

"My dear fellow, you had no cause to worry. In fact, the worry was the other way around, for you were his meal ticket. Although he is a trusted man, he was told he would lose his head if you came to harm."

A palace of some two hundred rooms was assigned for living quarters. A riding elephant, with a mounted escort of four men, provided transportation. These were the real "McCoy," for the elephant's trappings, horse equipment and weapons carried enough jewels to make a fair-sized fortune.

All the equipment had been brought in over the "pass" and had to be delivered to its final location. Man-power was unlimited, and everything was moved by mounting on long poles and attaching carrying poles with short ropes. The men were graded, by height, into groups of four or six, and their rope adjusted so that they would lift their share when they straightened up under their carrying sticks. Some of the

heavier pieces required over one hundred men. All of it had come in over the rocks by man-power. How that had been done was a never-ending wonder.

The royal storehouses were almost endless and contained an almost unbelievable amount of and variety of equipment. His Royal Highness subscribed for many scientific and farm papers and magazines, and whenever he saw something new pictured he ordered, "One like that." A complete American threshing rig was in the royal stores. This had been assembled, tried once, and then put away. A cross-compound engine had been brought in by man-power. This had never been assembled, but the shaft had been fitted with wooden bearings on the journals, attached to a pair of heavy thills, so that an elephant could drag it as a road roller. The roads *must* be packed hard for the royal automobile.

Perseverance, tact and skill finally completed the installation, and light and power were supplied the capital city and the royal palaces. The erecting engineer was then given a "gratification" equal to a year's salary, a wonderful letter of commendation and the royal permission to depart.

The permission came late one morning, rather unexpectedly, and, in conversation it was mentioned that the biweekly train left railhead next morning and that it was then too late to make connections. "If you want to catch that train, it can and will be done!" Orders were immediately issued, and things began to move rapidly. Carriers would be necessary over the "Pass." So, to save time, they started out that way.

One group, double the usual number, carried the engineer and another his baggage. There were enough extra carriers to make two additional double shifts. These men were trained to "break step" and travel at a shuffling trot, to keep the chair on an even keel.

The Midnight Express

They climbed the Pass and made the end of the road just before dark. Orders had been sent ahead, and there was a royal elephant, as big as a house, for the engineer, and a small one for his baggage and equipment. After refreshments, they started out on a weird and unforgettable journey,—black dark, so black that the mahout on the elephant's head was invisible. A lighter streak overhead was where the sky showed in the gap the road made through the trees. No sound except the creak of the harness, or, occasionally, the driver calling on the "Pearl of Elephants" for speed.

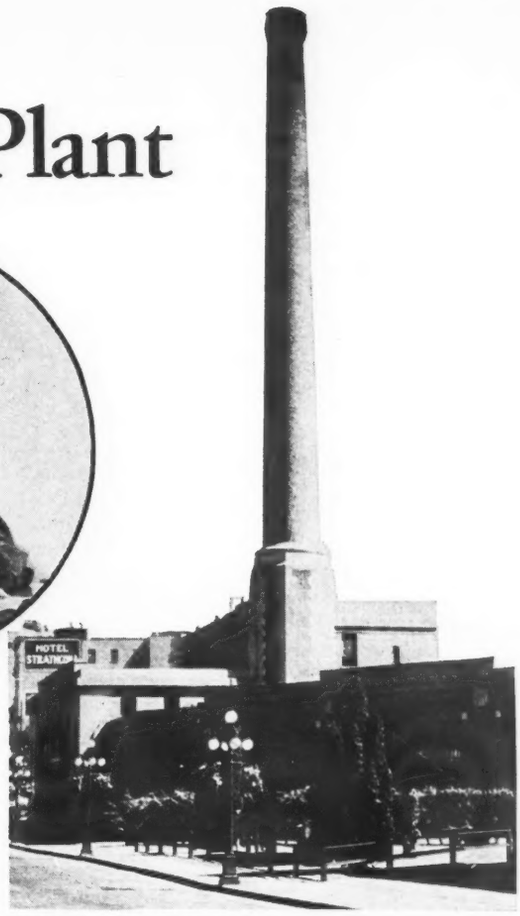
Anyone who thinks an elephant can not travel has another think coming. If one makes up his mind he want to catch a train, he just catches it! An Englishman who has spent all his life with elephants in India once said, "Starting from standstill, a man would have to do the first 100 yards under ten seconds to be even with the elephant. Then, the elephant is just nicely up to speed and can go on almost indefinitely."

Just at daylight, they made railhead, but all in vain, for the baggage elephant had wandered off into the jungle, gotten lost, and was not located for several days. However, time means nothing to the Far East, and the erecting engineer brought home memories of many fine friends and pleasant experiences, together with the joy that comes from a hard job well done.

Top-Notch Hotel Plant

UP NORTH and way out West, Canada's Vancouver Island—big as New Hampshire and Vermont combined—lies in the Pacific, pointing south across the straits to the Olympic Peninsula, the visible northwest corner of the United States. Vancouver Island is a land of "milk and honey", actually one of timber, fish, scenery, berries and delightful countryside. On its southern tip sits the queenly little city of Victoria, "world's most English Town outside of England." The world-famous hotel that dominates Victoria's harbor is well named "Empress"—a model of the genteel English tradition. Behind it, and across the street, is the hotel power plant. Here no traditions reign, except those of efficiency, modern equipment and dependability.

Stanley Rennison, chief engineer



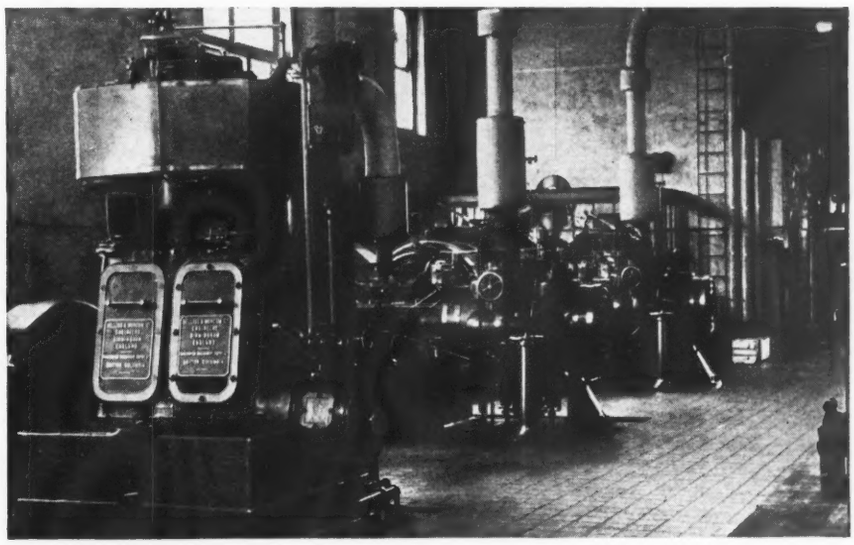
Stack marks plant proper, with laundry front and center

Lord of this mechanical kingdom is Chief Engineer Stanley Rennison, English born, English trained in the school of hard knocks, long a Canadian citizen. Stanley, a long-time POWER reader, gave the editor a good hand when he dropped into the plant last summer. These pictures and data are a byproduct.

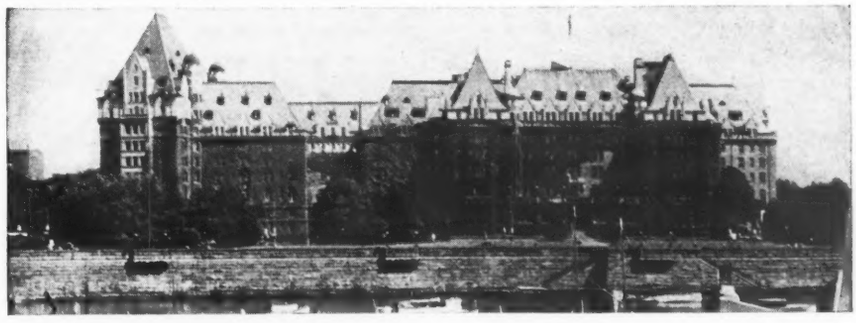
The Empress power plant, new in 1930, has three 2500-sq-ft Kidwell boilers built by Canadian Vickers of Montreal. Powered by Jones underfeed stokers, these generate steam at 160-lb pressure to drive three 120-volt, dc, steam-engine generating sets, one Belliss & Morcom, 225-hp, 150-kw, 430 rpm, and two Skinner Unaflows, 100-hp, 75-kw, 275-rpm.

With a big hotel to heat, a swimming pool next door, and a large modern laundry incorporated in the power plant building, there are plenty of uses for exhaust steam. This laundry, by the way, does the wash not only for the hotel, but also for coastal and trans-Pacific ships of the Canadian Pacific Railroad. Other steam-plant equipment includes Weir vertical feed pumps, Sturtevant forced-draft fans and Swartwout open heater. The steam fuel is washed pea coal, semi-bituminous.

From personal inspection, on an unannounced visit, the editor can vouch for the fact that this plant is scrupulously clean, a workmanlike job directed by a man of intelligence and good will—the sort of an engineer we all like to meet.



Power is generated by one 150-kw diesel set (not shown) and three steam units, a vertical 150-kw and two horizontal Uniflows, 75 kw each. Below, the Empress Hotel



Speaking of Power

Before October POWER was off the press, I had to break away again to keep an appointment to speak before the American Hospital Association convention in Toronto (Sept 27) on hospital power plants —chiefly on what's the matter with them. Which is plenty, with due apologies to some notable exceptions. . . . As I see it, and as I ventured to say in Toronto, the basic trouble with hospital power plants is that they don't believe in going to a doctor when they are sick. If they go to the

No doctor when ailing

"doctor" (meaning some power engineer who knows his business), they don't take the medicine he prescribes — say they can't afford it. Maybe they think it's cheaper to be sick than to take the cure.

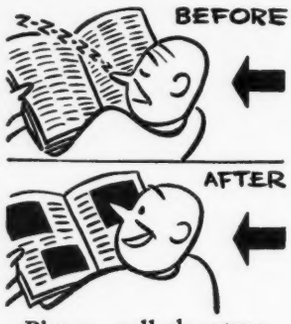
When I recommend spending a little hard-to-get money on essential meters, maintenance and engineering talent (both practical and technical), I do so on one basis only—that of getting more community health service out of every dollar expended on hospitals. . . . It isn't a question, as some think, of taking money away from much-needed medical and operating facilities to spend on the hobbies of the power engineer. . . . It *is* a question of allowing the power engineer to make certain little investments that will return 25%, 50% and sometimes 100% yearly with which to buy the things the doctors say the hospital needs and cannot now afford.

Getting back to this war business—and we can't get away from it for long—I note, with sympathetic appreciation, that both of our leading British contemporaries, *Engineering* and *The Engineer,* have moved their publishing offices from London to distant parts, less exposed to air raids. . . . In America we note a powerful public sentiment against involvement in this war. This feeling is just as strong in industrial circles as among the rank and file of Americans who don't fancy sending their sons abroad to face bullets, gas and bombs in another European free-for-all. . . . That there may be no question

Powerful sentiment

about their attitude, many well-known companies and some of the leading business associations (for example, National Association of Manufacturers) have issued strongly worded statements against American involvement.

A September vacationist was George Edwards, father of "The Operating Engineer", who reports the New Hampshire mountains very beautiful at this time of year. . . . We had occasion to be thankful that he came back rested and in a mellow mood, because when he came into the office around the first of October to see how we were treating "his baby", he was somewhat uncomplimentary about the October number of "The Operating Engineer". . . . His principal objection was that we had cut down on the number of illustrations in his section, and made it rather stodgy looking. We went out and did something about it this month. The article, "If You Want It Done Right, Make It Easy", page 99, made George feel much better. The rest of the section follows this pattern, as will other issues of The Operating Engineer, because George says (and he's right) that we've got to make our articles for practical men clear, concise and graphic. Nobody wants to read cold type when pictures tell the story better.



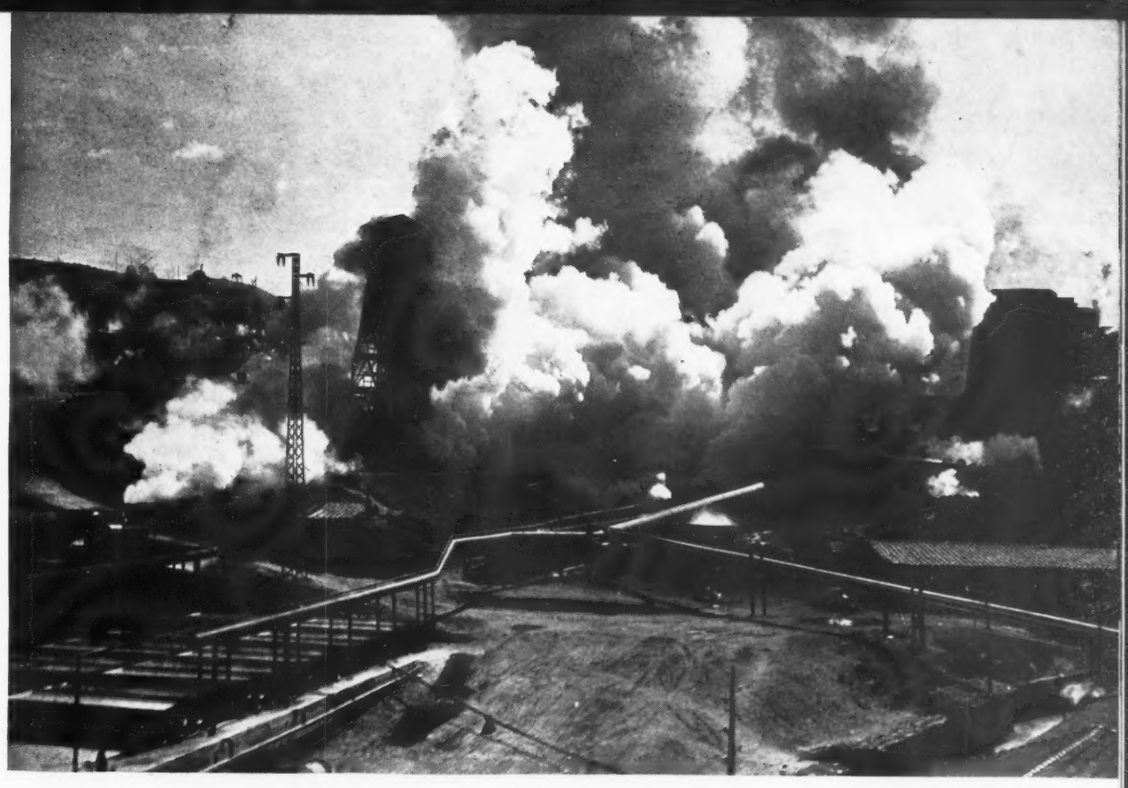
Pictures tell the story

Several times in recent years POWER has joined the battle over engineers' titles. In brief, we have fought the repeated attempts made by professional engineering groups, here and there, to restrict the title "engineer" to men with professional licenses. . . . To be fair and consistent, we must now quote with approval from an editorial in August *Professional Engineer:* ". . . . No matter how much we legislate, a term established by so many years of usage as lies back of the public's conception of 'engineer' can never be delimited and made precise in the designation of a single branch. . . . We must agree on a term that will be distinctive . . . . probably 'professional engineer' " . . . . That's talking sense. We hope this statement marks the beginning of the end of a long and hopeless struggle against the law of gravitation. It's hard enough to change any universal custom. When, in addition, your case is both unsound and unpopular, why try?

Can't restrict custom

When Joshua blew his horn and brought down the walls of Jericho, he set a precedent for later warriors, statesmen and editors who had something to brag about. We hope you will pardon us for a modest toot (we promise it won't bring down any walls) for an Award of Merit given us in recognition of the Handbook of Hookups (POWER, December, 1939). The magazine *Industrial Marketing* has for two years sponsored a competition among business publications, with awards this year in five classifications — ours was for excellence in pictorial reporting. The framed certificate now hangs in my office as a tangible reminder of over 2000 man-hours of work.—PWS

POWER gets an award



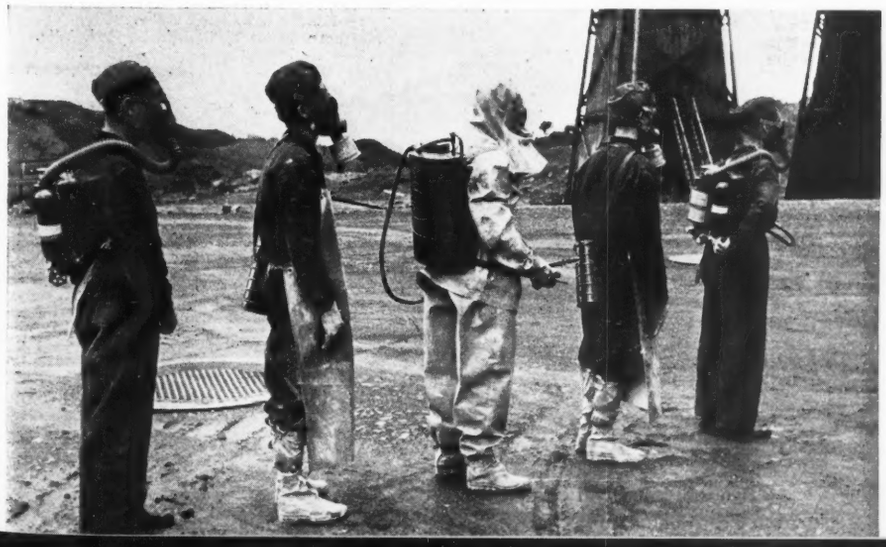
Drilling a steam well has as many possibilities for surprise as playing catch with a chunk of nitroglycerine. No one knows whether steam is 100 ft down or 1000, and what's worse, no one knows whether piercing the crust may be the one straw that will blow the roof off the Larderello valley. Both percussion and rotary drilling are used, water being pumped into the well to keep the steam down until the casing is sunk to the bottom. Casings have to fit much more tightly than in oil wells, to get every lb of steam pressure available

Steam by Vulcan

"LIVE" STEAM with a vengeance—that's what Italian engineers are harnessing in the volcanic Tuscan hills, the only place in the world where natural steam is put to extensive work producing power.

It's a power plant like none other in the world. Twelve turbines, in four towns, Larderello, Castelnuovo, Serrazano and Lago, turn out 1,250,000 kwhr every 24 hours, which is sent over high-tension lines to Rome, Pisa, and many towns between—and all this without benefit of boilers except those underground volcanic units stoked by Vulcan himself.

Larderello's volcanic steam goes to work in two ways: to heat water in evaporators like those in this picture, producing pure steam for the turbines; or where higher steam pressures are available, to expand directly in the prime movers. More than 8,000,000 tons per year of pure borax, carbonic acid, ammonia, and boric acid appear as byproducts of the volcanic-steam-well harnessing



This isn't an air-raid cleanup squad, but a steam-well rescue gang, ready to do what it can when a well strikes steam unexpectedly and the gargantuan underground forces spew forth steam, boiling water and mud, and blast drilling machinery and buildings to matchwood with a roar that can be heard for more than 10 miles

RILEY scores a bull's-eye

again Riley performance exceeds guarantees . . .

If you were to investigate—and we would be glad to have you do so—the performance of the Riley "RP" pulverized coal fired steam generating units at the Winchester Repeating Arms Company, New Haven, Conn., we are sure you would agree that Riley has again scored a bull's-eye. These units are operating at an efficiency of 87.4% though the guaranteed efficiency was only 86.5%. The units have produced continuously 90,000 pounds of steam per hour with peaks of 100,000 pounds, while guaranteed capacity was but 75,000 pounds per hour. Even pulverizer power guarantees were bettered. Against a guarantee of 12.44 K.W. per ton, to the pulverizer motors, only 10.6 K.W. per ton is actually required.

Such performance is all the more remarkable when it is considered that this outstanding performance was obtained from the time the units were first placed on the line. It was not necessary to make changes to bring about these results—to get superheater steam temperatures to the figures guaranteed.

The ease and smoothness with which these units were placed on the line is characteristic of Riley Units. Here is the story of how these units started up:

July 28 First unit brought up to 650 lbs. pressure
July 29-31 Placed on line, testing steam lines and turbine
August 2 Unit placed on line
August 3 Second unit brought up to pressure
August 13 Both units placed into continuous regular service

And so with characteristic Riley ease, two additional Riley "RP" Units were placed into satisfactory service, adding further to the excellent performance record of Riley Steam Generating Units.

There is a reason back of the ever-increasing popularity of Riley equipment. On practically all recent Riley installations, performance guarantees have been exceeded. Riley has given its users more than their money's worth. It is because of the extraordinary performance of Riley Units that we say "It will pay you to visit modern Riley installations before purchasing boiler or fuel burning equipment."

PARTIAL LIST OF RECENT RILEY

Central Illinois Light Co., Peoria, Ill.
1—375,000 lbs./hr.–900 lbs.–900°F.
Repeat order
Houston Lighting & Power Co., Houston, Texas
1—250,000 lbs./hr.–975 lbs.–910°F.
Large Eastern Oil Refinery
1—300,000 lbs./hr.–744 lbs.–740°F.
Repeat order
W. Va. Pulp & Paper Co., Covington, Va.
1—375,000 lbs./hr.–650 lbs.–720°F.
Repeat order
W. Va. Pulp & Paper Co., Luke, Md.
1—375,000 lbs./hr.–650 lbs.–720°F.

Shell Oil Co., Wood River, Ill.
1—125,000 lbs./hr.–700 lbs.–750°F.
Worcester Salt Co., Silver Springs, N. Y.
1—150,000 lbs./hr.–250 lbs.–465°F.
Union Public Service Co., Canby, Minn.
1—75,000 lbs./hr.–515 lbs.–825°F.
Peter Cailler Kohler Swiss Chocolate Co., Fulton, N. Y.
1—85,000 lbs./hr.–250 lbs.
Masonite Corporation, Laurel, Miss.
1—60,000 lbs./hr.–450 lbs.
Norton Company, Worcester, Mass.
2—50,000 lbs./hr.–725 lbs.–750°F.

Agfa Ansco Corp., Binghamton, N. Y.
1—61,000 lbs./hr.–475 lbs.–700°F.
U. S. Military Academy, West Point, N. Y.
1—150,000 lbs./hr.–160 lbs.
City of Norwich, Conn.
1—75,000 lbs./hr.–725 lbs.–750°F.
Ohio Salt Co., Rittman, Ohio
1—120,000 lbs./hr.–275 lbs.
Northern Paper Mills, Green Bay, Wis.
2—75,000 lbs./hr.–700 lbs.–700°F.
Port Hudon Sulphite & Paper Co., Port Huron, Mich.
1—80,000 lbs./hr.–675 lbs.–710°F.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

It will pay you to visit modern Riley Installations

If practice makes perfect, 17 million shots should make a world's champion. They were fired during the past fifty-two years by a rifle tester in the New Haven plant of the Winchester Repeating Arms Co. Result: some 2,500,000 rifles tested and approved—some shooting record.

at WINCHESTER

facts about the performance of Riley "RP" units at Winchester Repeating Arms.

Actual Efficiency—87.4%

Guaranteed Efficiency—86.5%

Actual Maximum Capacity—90,000 lbs. per hour

Guaranteed Maximum Capacity—75,000 lbs. per hour

Actual Power Consumption, Pulverizers, when pulverizing 5,000 lbs./hr.—10.6 K.W./ton

Guaranteed Power Consumption—12.44 K.W./ton

Steam Pressure—725 lbs. Steam Temperature 750°F.

Unit consists of Riley boiler, superheater, water-cooled furnace, air heater and steel-clad insulated setting fired by Riley Pulverizer and Burner

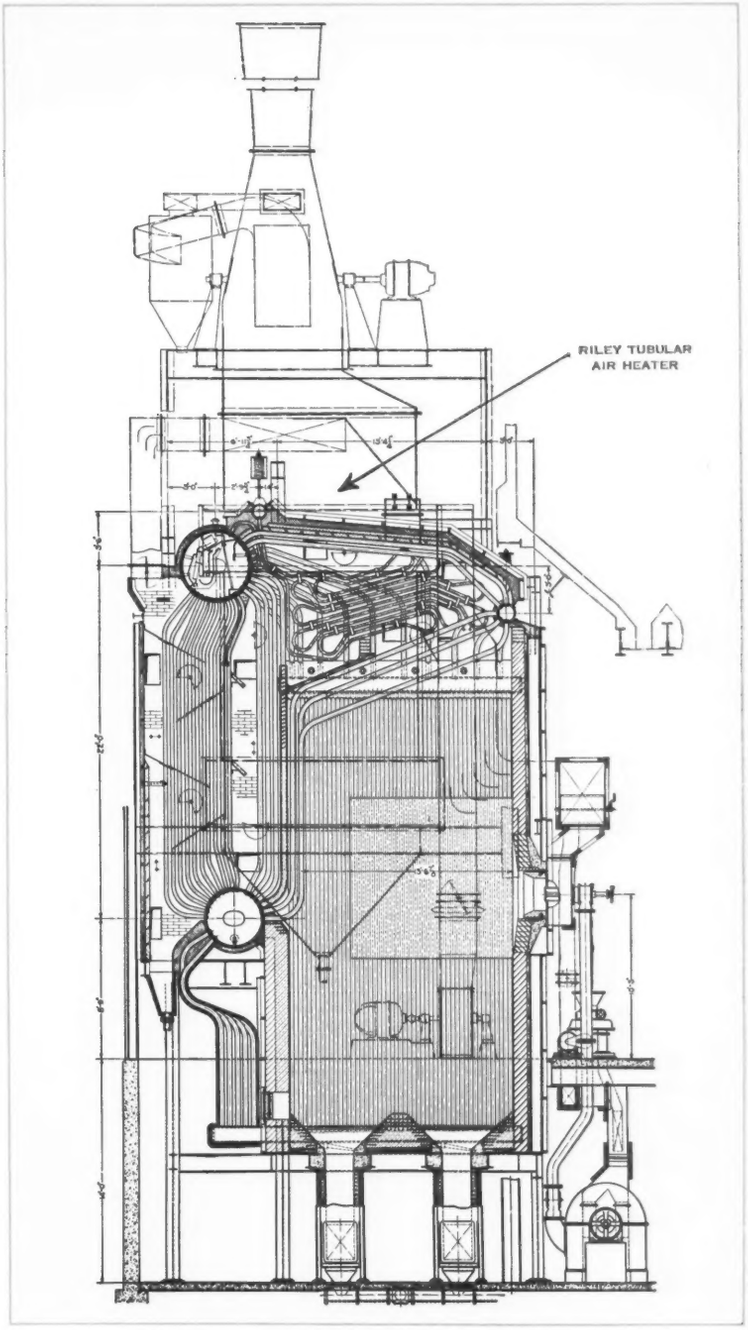
BOILER SALES

Crown Cork & Seal Co., Baltimore, Md.
1—90,000 lbs./hr.–200 lbs.
City of Columbus, Ohio
1—150,000 lbs./hr.–475 lbs.–750°F.
Allis Chalmers Manufacturing Co., Milwaukee, Wis.
2—150,000 lbs./hr.–200 lbs.–452°F.
Western Cartridge Co., E. Alton, Ill.
2—75,000 lbs./hr.–725 lbs.–750°F.
Winchester Repeating Arms Co., New Haven, Conn.
2—75,000 lbs./hr.–725 lbs.–750°F.
Great Lakes Steel Corp., Detroit, Mich.
2—100,000 lbs./hr.–450 lbs.–700°F.
Natrona Power & Light Co., Natrona, Pa.
1—90,000 lbs./hr.–450 lbs.–700°F.
Otter Tail Power Co., Wahpeton, N. D.
1—130,000 lbs./hr.–600 lbs.–825°F.
Helwig Silk Dyeing Co., Philadelphia.
1—113,500 lbs./hr.–450 lbs.
Lewiston Bleachery, Lewiston, Maine
1—72,000 lbs./hr.–450 lbs.–668°F.
Libby Owens Ford Glass Co., Rossford, O.
1—175,000 lbs./hr.–450 lbs.–775°F.
General Aniline Co., Kenosha, Wis.
1—80,000 lbs./hr.–250 lbs.–471°F.
Godchaux Sugars, Inc., Reserve, La.
1—100,000 lbs./hr.–475 lbs.–560°F.

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs.

COMPLETE STEAM GENERATING UNITS

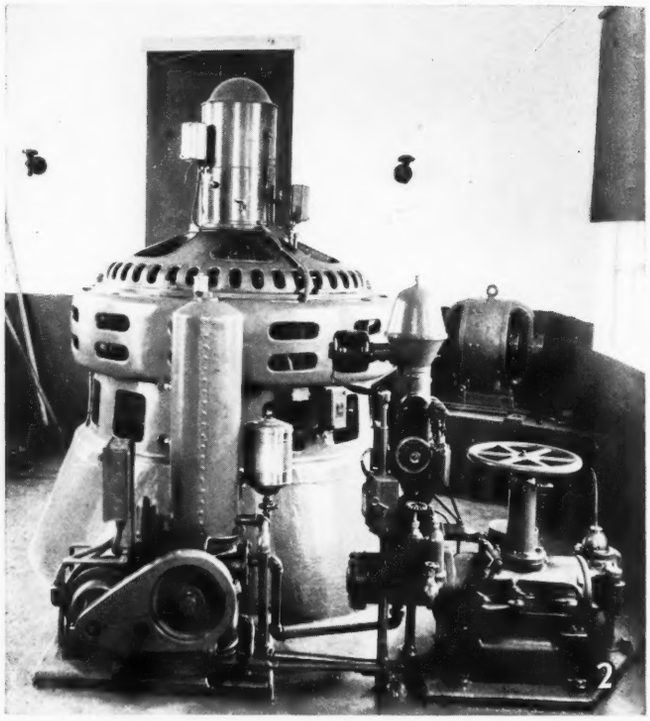
BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS
AIR HEATERS • ECONOMIZERS • WATER-COOLED FURNACES
STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

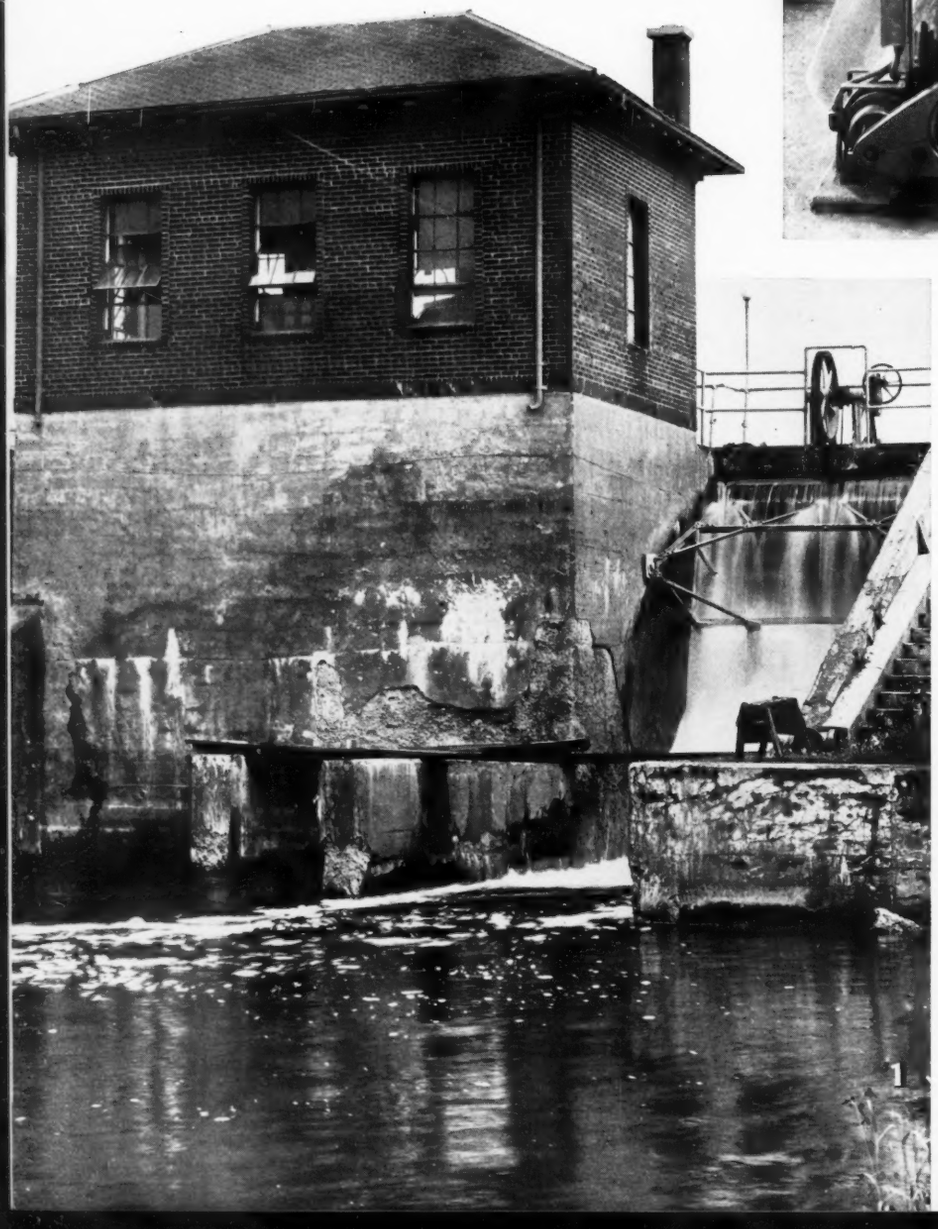


Winchester Repeating Arms Co., New Haven, Conn.
2–75,000 lbs. per hour Riley Pulverized Coal Fired Units
Arthur L. Nelson, Consulting Engineer

before purchasing Boiler or Fuel Burning Equipment

Diesels Rejuvenate Tottering Hydro

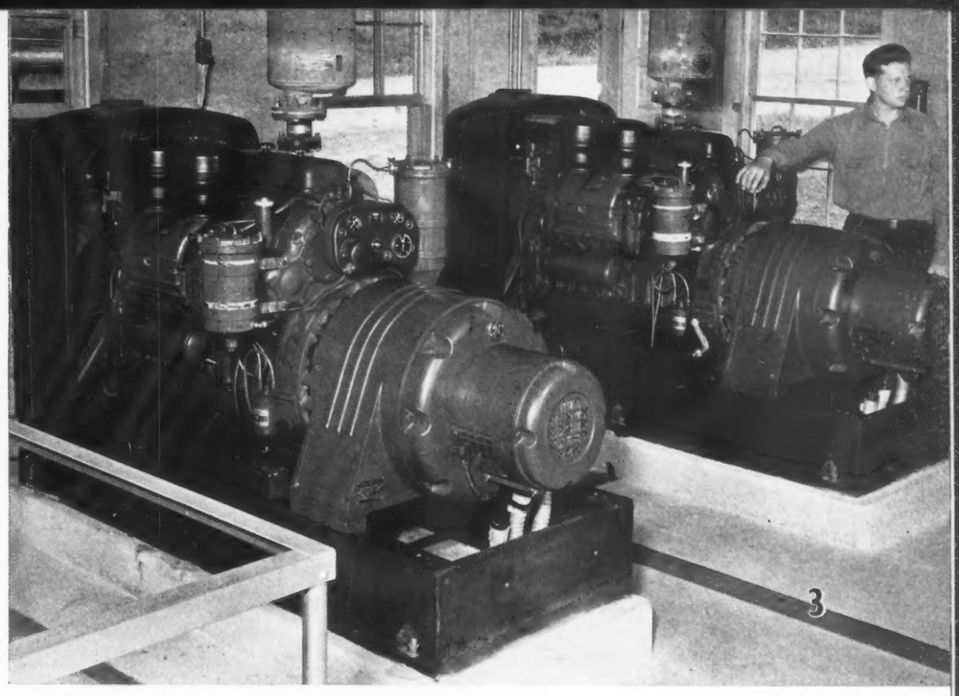




RESIDENTS OF BELLAIRE, MICH., in the heart of the Grand Traverse Bay resort section, are easier to live with these days. Housewives no longer worry about fallen cakes. The barber can now offer you a dry shave. Ten or more kerosene, wood or coal ranges have given way to bright new electric stoves, and there is a dependable supply of hot water in homes blessed with electric water heaters. Even the dentist is happy, if not the patient in his chair, for he knows there is little likelihood that the motor powering his drill will fade out while excavating that big cavity.

All this came to pass when village officials decided to buy diesels to rejuvenate the tottering hydro plant that was the sole power source. Here's the story:

1. No gas is available around Bellaire. All electrical energy used to come from a single waterwheel on the

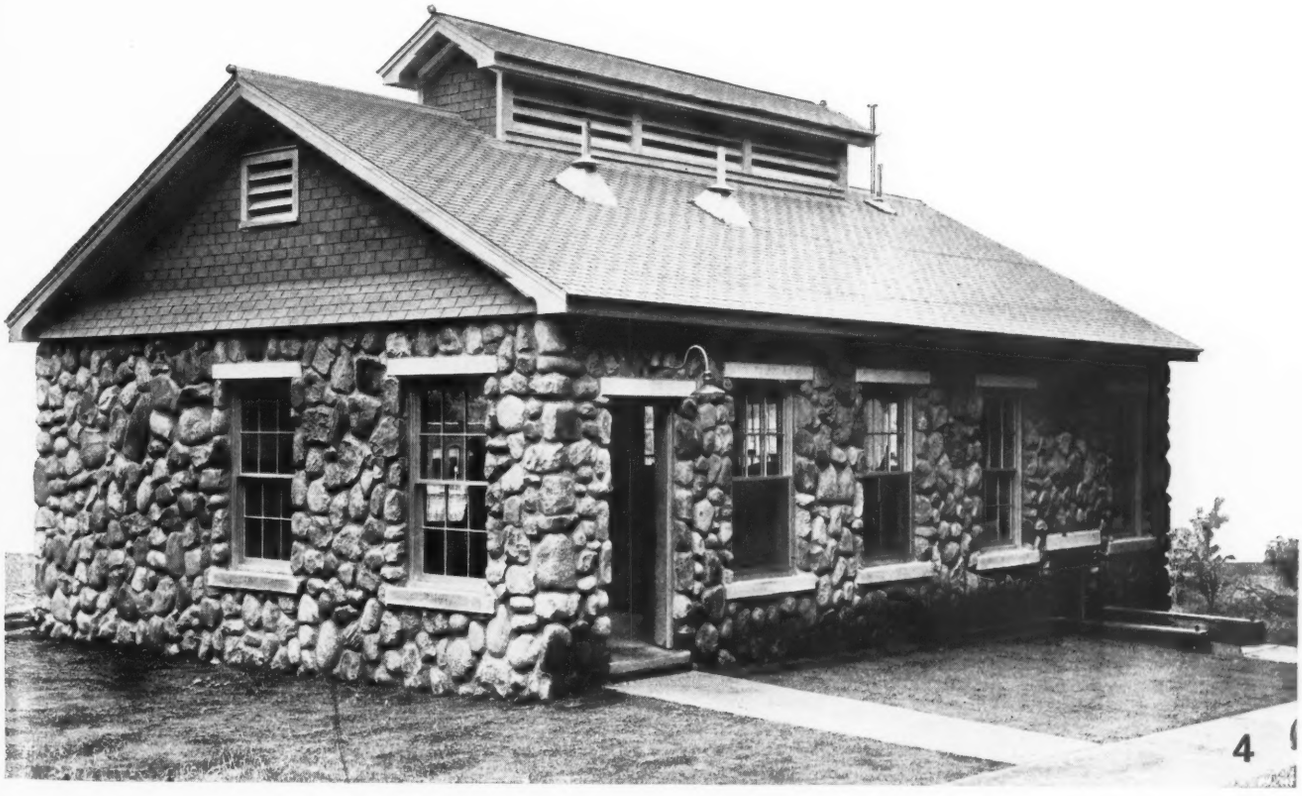


Cedar River, half a mile from town. The wheel drives a 75-kw, 2300-volt, ac generator.

2. The generator is equipped with a governor, but with the passing of years, parts of this expensive mechanism had worn to such an extent that current supplied to the village (nominally at 110 volts) fluctuated as much as 15 volts and varied from 50 to 70 cycles. This somewhat erratic performance made electric cooking extremely difficult and the operation of fractional horsepower motors almost impossible, not to mention the annoyance caused by dimming lights. The annual influx of summer visitors, swelling the population from a normal of 580 to 1200, made matters worse, and the fact that summer means low water in the river didn't help any.

3. Purchasing two diesels for auxiliary and standby service solved the problem. These 6-cylinder, 2-cycle, 1200-rpm General Motors units drive 2300-volt, 60-cycle, 3-phase, 60-kw ac generators operated in parallel with the old waterwheel generator, turning at a lazy 180 rpm. Service has been so satisfactory that instead of operating one of the "packaged power" units from 5 PM to midnight, as planned originally, it is now started at 9 AM. The other unit serves as standby; in case of water failure, the two diesel generators can carry the entire community. Both diesels are fitted with synchronous governors. During the day, the working set does little more than smooth out fluctuations caused by erratic behavior of the waterwheel.

4. This fieldstone building houses the "packaged power" units and a 100-gpm rotary pump, driven by a 50-hp motor, that draws water from an artesian well for the village water supply. There is room for one more diesel-generator set if needed later. Although in a residential section near the center of the village, there have been no complaints. Silencers effectively smother noise and the exhaust runs clear. Fuel consumption records kept by the municipality show an average of 11 kwhr per gal. of fuel oil, good performance considering the highly variable load. The installation was made by the Wolverine Diesel Power Co, of Detroit.



For Snappy Performance—

IN THE WORDS of an enthusiastic customer: "Armstrong Unit Trapping makes old equipment work like new and new equipment work better than you ever thought it could!"

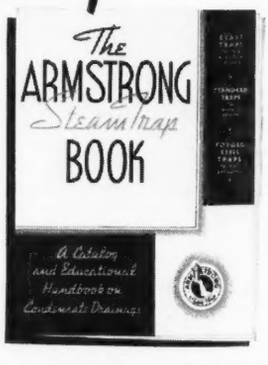
This is a strong statement, but we believe that Armstrong traps backed up by Armstrong Representatives can make good on the promise. These men have had wide experience in the application of Armstrong traps and can give you valuable assistance when it comes to increasing production capacity and straightening out kinks in heating systems.

Armstrong traps are offered in a complete range of sizes and styles for every purpose. In each size, you get the genuine inverted bucket operating principle with the patented Armstrong free-floating valve. For complete information about Armstrong traps and Armstrong service, write or call. ARMSTRONG MACHINE WORKS, 812 Maple St., Three Rivers, Michigan.

VALUABLE INFORMATION for Engineers

IF YOU have anything to do with the design or operation of power plants, process plants, or heating systems, we believe you will be very much pleased with the new Armstrong Steam Trap Book. Out of a total of 36 pages, 18 are devoted to data book material on condensate drainage, heat transfer, piping layouts, trapping practice, maintenance ideas, and other useful information never before found in such compact and convenient form. Regular users of Armstrong traps will also be pleased to find new style catalog pages listing Armstrong products with great completeness and detail.

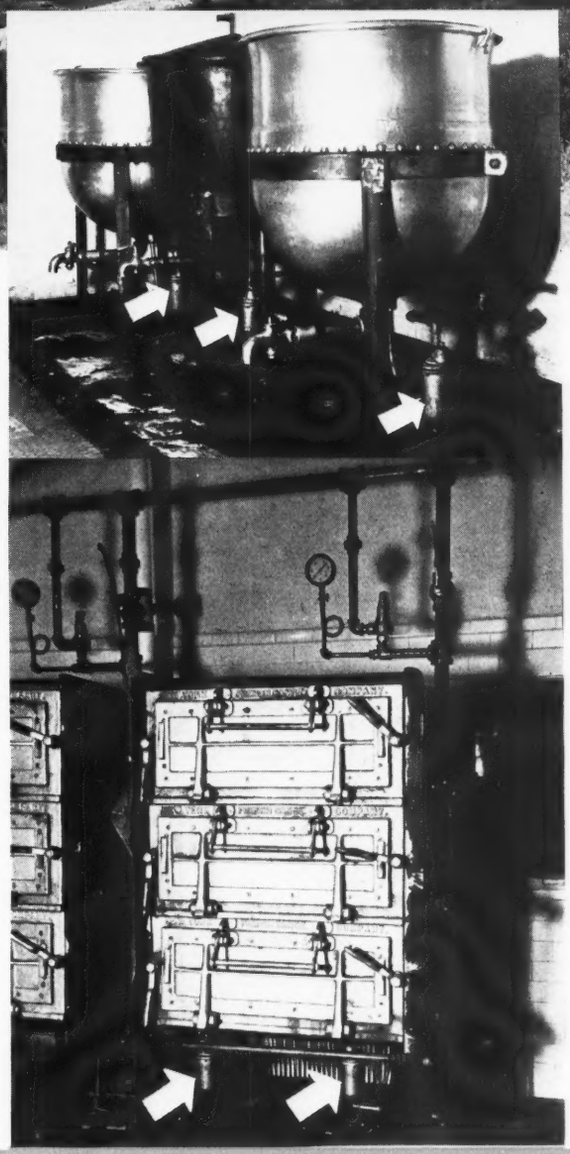
Your local Armstrong representative will be glad to provide you with a copy of this new book, or write. No obligation.



JUST OFF THE PRESS

Change over to ARMSTRONG

NEW YORK MILITARY ACADEMY
CORNWALL-ON-THE-HUDSON, N.Y.



BEFORE

FORMERLY. Prior to modernization of the trapping system at New York Military Academy, WATER HAMMERING in the heating lines regularly awakened everybody long before reveille.

●

FORMERLY. Even with the early start, rooms didn't warm up until later in the morning.

●

FORMERLY. In the kitchen, it took 45 minutes to cook potatoes and they were soggy. Soup kettles had a hard time getting enough steam when the vegetable cookers were in use.

●

FORMERLY. In the boiler room, the high steam consumption made the boiler act like it was being blown down continuously.

AFTER

NOW. No water-hammering to disturb early morning slumber—thanks to the change-over to ARMSTRONG UNIT TRAPPING.

●

NOW. Buildings heat up in half the time formerly required.

●

NOW. Recommendations made by the Advance Engineering Co. of New York (Armstrong Representatives) included the vegetable cooker hook-up shown at the left. With it, potatoes now cook in 25 minutes and are nice and dry.

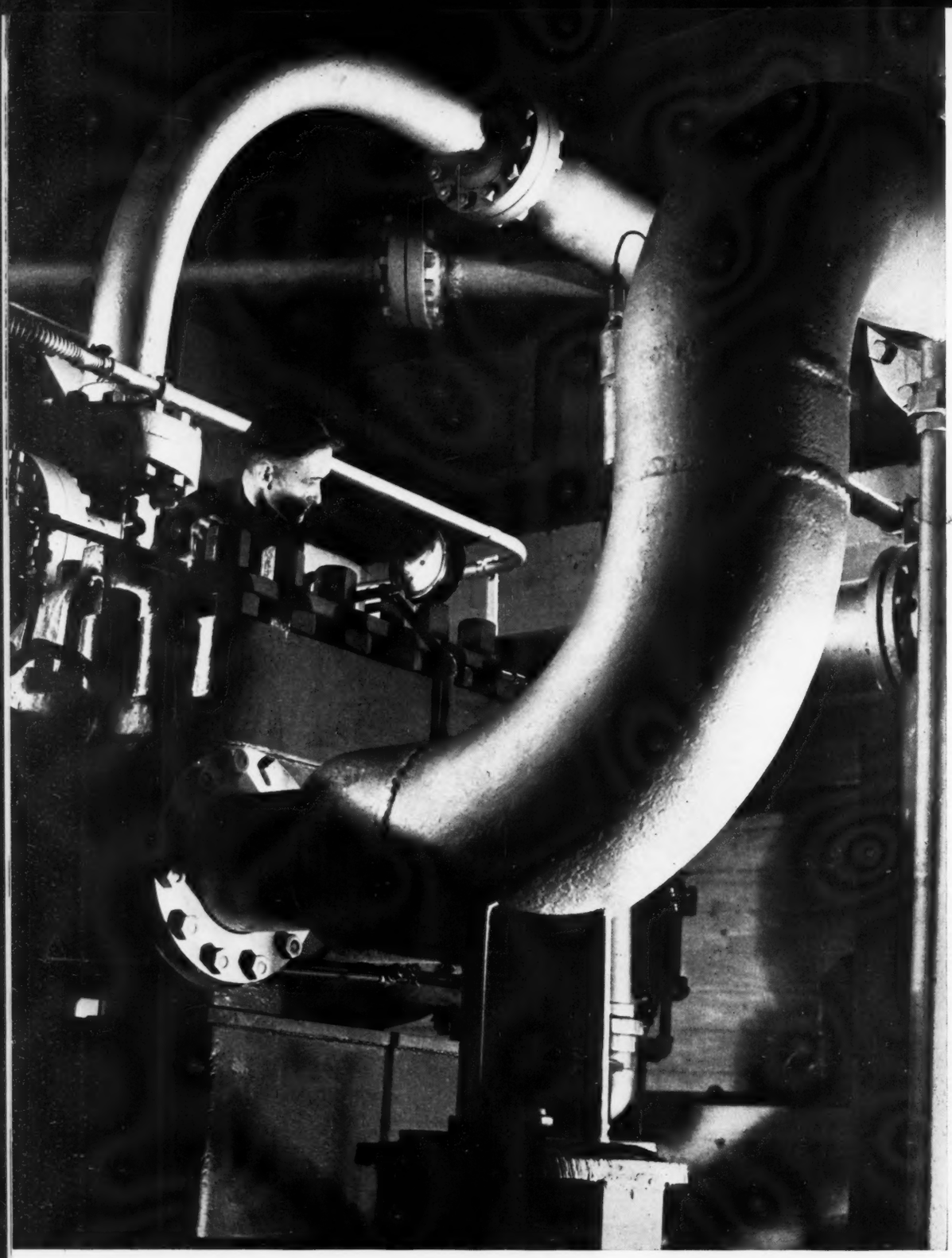
●

NOW. After the traps were put in, hams cooked so fast in the kettles that the skins were cooked off the first time before the cooks realized it.

●

NOW. The boiler plant handles the load easily with plenty of pressure to spare!

UNIT TRAPPING



Steel Skyrockets

As production skyrockets past 85, power men in the steel mills are called on to get every Btu out of boilers, every watt out of turbines. Here at the 96-in. continuous strip mill of the Jones & Laughlin Steel Corp, Pittsburgh, an engineer keeps a watchful eye on the turbine pressure gage as 39,000 hp of motors roll out sheet for American industry

THE OPERATING ENGINEER

George Edwards
Advisory Editor

Practical Aids
Maintenance Hints
Questions — Answers

Published monthly as an integral part of POWER

If you want it done right
MAKE IT EASY!

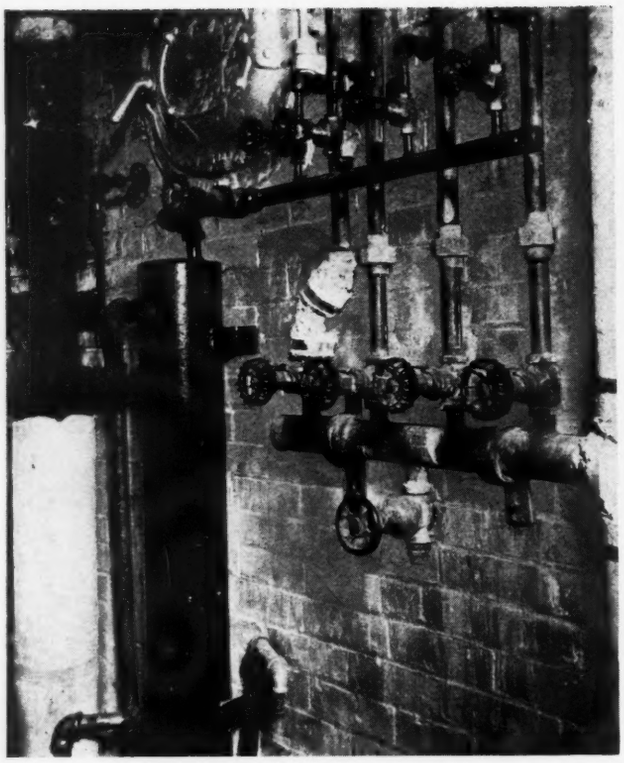
That's John Matson's Yankee recipe for topnotch power-plant operation. Here are a few pictures showing the many ways he puts this idea to work at R Wallace & Sons Mfg Co, Wallingford, Conn.

JOHN MATSON believes in what he calls "strategy"—thinking up schemes for licking those little troubles that crop up in all power plants. Running what amounts to a small central station (the R Wallace plant serves three industries) he knows that his first job is to meet all load demands. His formula is simple—"If something goes wrong, fix it so it won't happen again." And he'll tell you that if you just start out to fix something that doesn't behave the way it should, nine times out of ten some improvement will pop into your head while you're working.

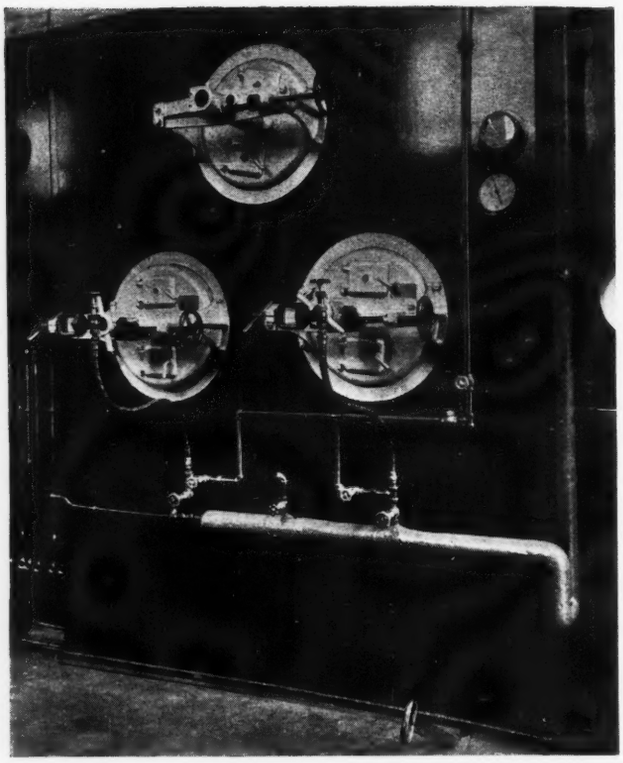
Actually, this "kink" business goes deeper than solving mechanical problems. John Matson knows from experience that the best way to make sure routine operating jobs are done when they should be and done right, is to make doing them easy. Following this line gives him a byproduct that's really worthwhile—kinks and labor-saving ideas give his men spare time. Because the whole force is sold on the idea of better operation, time saved is used for scheming more strategy and for building new or improving old equipment to make the schemes work.

CONTINUED ON NEXT PAGE

Some of the best ideas are hatched out right on the spot; others come to light in this corner of the Chief's office, where the gang holds "Figure-Out Board" meetings occasionally. Note the handy rack for meter charts; spring-type clothespins hold the piles flat and prevent loss. By using different color ink each year, most charts can be used for three or four years



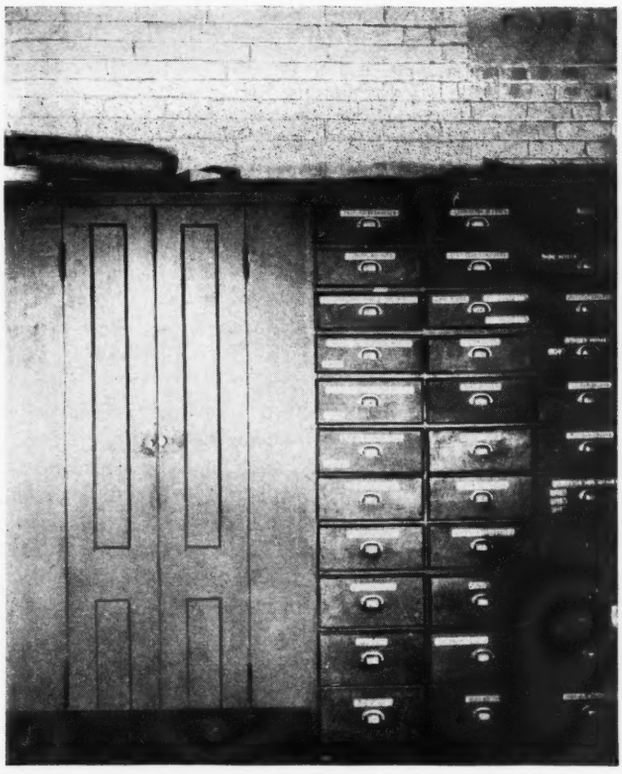
If boiler-water tests are to be worth anything, samples must be taken regularly and correctly. This homemade setup draws samples from all four boilers, and, by means of the cooler, delivers accurate, cooled samples



Better burner operation results from the simple stunt shown here. ½-in. steam lines, hooked into each oil line ahead of the burner, permit blowing steam through burners on shutdown and startup, keep tips carbon-free

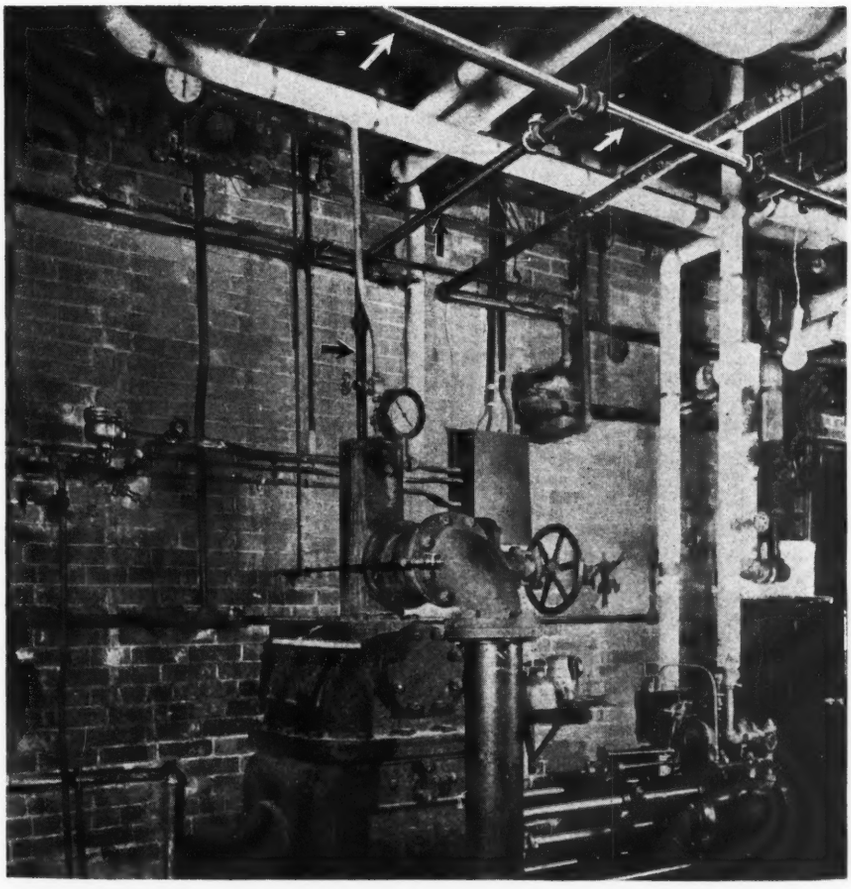
The R Wallace boiler room is a one-man job. Setting up instruments and controls in one spot gives the fireman a practical working headquarters that saves time and steps. You can bet he does a good job—it's been made easy

A smoking stack is bad public relations and it spells poor combustion. Rigging a mirror to spot smoke isn't new, but this one is put where the fireman can't help seeing it—there can't be any alibi for smoke with such a rig



Keeping spare parts carefully sorted and filed away in plainly marked drawers will speed repair jobs in any plant. This cabinet is a dividend from labor-saving boiler-room kinks—the fireman made it in his spare time

Here's another spare-time product from the fireman's carpenter bench in the boiler room. Making daily boiler-water tests is a lot easier now with equipment at hand and a place set up for testing. Tests control treatment



This vacuum pump for the heating system does double-duty—by means of the line indicated by the arrows, running to the service pump and the circulating pumps, it keeps those units free of air, ready for instant starting

THE THING TO REMEMBER from this picture record isn't any one of the kinks, it's the idea of putting your brains and your men's brains to work bettering plant operation. Get the habit of curing troubles by improvements. Get the habit of looking around for spots where operation can be made easier or safer—and then do something about it. Pretty soon you and your men will be feeling like the gang up at Wallingford—kind of ashamed if a week goes by without something being done to better plant operation.

DON'T Get the "CREEPS"

What's belt creep all about? What harm does it do? Can it be prevented? How does it differ from slip? Here are the answers

ALL BELTS CREEP on their pulleys and they *may* slip. Both actions are produced by different causes, but they both cause power loss. Slip can be prevented by properly applying belts and is something that the engineer can control. Creep, however, is a part of the power-transmitting operation of a belt and nothing much can be done about it.

Fig. 1 shows a belt drive, having a driving and driven pulley of equal diameter. For the sake of study, thickness of the belt has been greatly exaggerated. When the belt is put on the pulleys, it must be given a certain tension (called initial tension) which is the same in both strands. This tension causes friction between the belt and pulley surfaces so that power can be transmitted from one pulley to another.

What happens to the belt when it transmits power, Fig. 2? The driving pulley on the left is turned clockwise by the source of power. To drive the driven pulley on the load shaft, the driving pulley must pull on the lower strand of the belt. As a result, tension increases in the bottom strand and decreases in the upper strand. This causes the former to stretch and become thinner and the latter to contract and grow thicker, as shown.

At the *driving* pulley, we deliver a long section of belt *A* to the pulley and it comes off a short section *B*. For example, assume a belt so elastic that when driving its load, the tight strand stretches to where one inch delivered to the driving pulley contracts to one-half inch by the time it reaches the slack side. Under such conditions, the length of belt would be delivered to the pulley twice as fast as the slack-side length comes off, the difference being adjusted by stretch in its tight side and contraction in its slack side.

On the driven pulley, a short section of belt C is delivered to the pulley and it comes off a long section *D*. In other words, the belt on the slack side is being delivered to the pulley at a slower rate than it comes off on the tight side. The belt is therefore creeping ahead on the pulley and its rim surface runs slower than the belt.

Since creep is caused by elasticity of the belt, it increases with the load, being very small at light loads and is usually less than 1% at full load on the usual well-designed belt drive. However, low creep does not necessarily mean that the belt is a good one. A belt of low overload capacity may have slightly less creep at full load than a high-grade belt of high overload capacity. This is because the good belt is a little more elastic than the poor one. On the other hand, high creep is a pretty sure indication of inferior quality, because belts made of soft spongy material are highly elastic and have high creep and power loss.

Creep Is Progressive

Belt creep occurs progressively around the surface of the pulleys as the load increases. Tests have shown that, at light loads, all creep occurs in a short section of the tight side of the belt in contact with the pulleys. As load increases, creep length increases around the pulleys until it covers the whole contact area of the belt, as in Fig. 2.

Under reasonable loads and initial tension, the difference between pulley surface speed and belt speed is due almost entirely to creep. If we increase load on a belt, we reach a point where the friction between belt and pulley is not sufficient to drive the load and the belt slips as a whole on either or both of the pulleys. This permits a slowing down of the load to where the belt can drive it.

If load is excessive, one of the pulleys may stall and the belt, if not restricted, usually flies off the pulleys. Slip of a belt is usually caused by operating it too slack, by overloading it, or because of the condition of the belt, pulleys, or both. It is the engineer's job to eliminate these causes insofar as possible, because belt slip represents a loss of power and will cause short belt life. On the other hand, do not operate belts too tight, because this overstresses the belt, causing short life and power losses, increases the loading on bearings and makes them more difficult to lubricate.

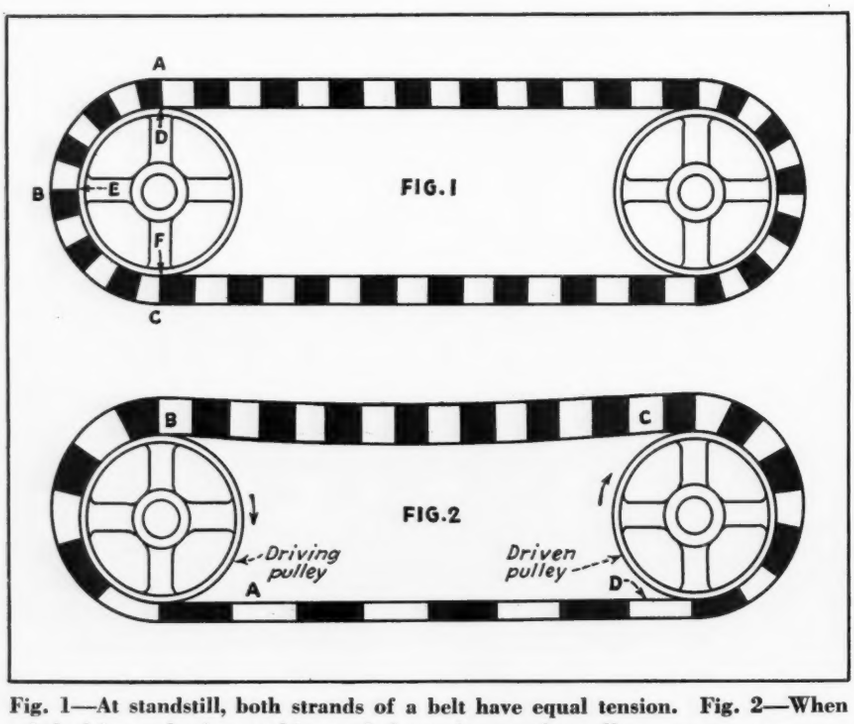


Fig. 1—At standstill, both strands of a belt have equal tension. Fig. 2—When a belt drives a load, stretching and shortening on the pulleys causes creep

It Pays to Be CAREFUL!

Internal inspection of a non-standard air receiver revealed serious construction weakness, saving one plant from the fate shown at right

By CHARLES A ARMSTRONG

This is what can happen to an unsafe air receiver, which exploded and came out through the side of the building, doing several thousand dollars damage and jeopardizing the lives of those nearby

THE BEST WAY to be sure that you are getting a safe and sound air receiver is to get one that bears the ASME unfired-pressure-vessel stamp or one required by a state. But there are many non-stamped air tanks installed today, and while some of these are safe and substantial, others are not. The problem is how to determine whether a non-standard tank will do its job without scattering itself over the plant.

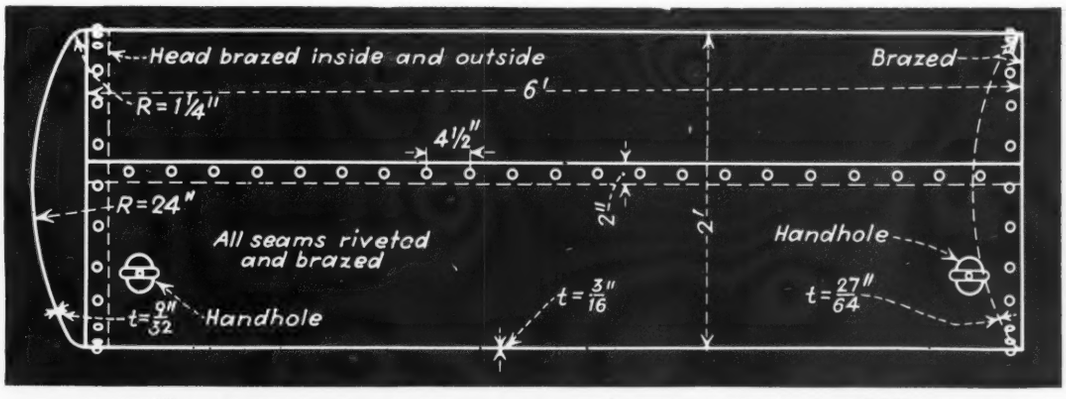
First, get ahold of the manufacturer and find out the physical and chemical properties of the materials used in building the receiver. Steel plate in shell and head of the tank should be flange or firebox quality, and should conform to the physical and chemical specifications of Paragraph U-13 of the ASME Unfired-Pressure-Vessel Code.

One point in receiver construction was definitely brought home to me by a non-standard air receiver examined recently, see diagram. Calculations based on the specifications indicated that the materials and dimensions were satisfactory for about 150 lb per sq in. pressure. The longitudinal seam lapped 2 in., exceeding by a good margin the Code requirement that it be at least 8 times plate thickness, in this case $\frac{3}{16}$ in. x 8 = 1.5 in.

An internal examination with a mirror, however, revealed an opening about one-half the length of the longitudinal seam. Brazing material had fallen out in a long strip; the small amount left in the seam solely prevented leakage, adding nothing to strength of the seam.

The seam's strength was then calculated, based on strength of the riveting. This showed that the tank had a factor of safety of only 1.24, instead of the required minimum of 5.

A working pressure of 150 lb is almost enough to cause immediate failure, and there isn't much question that in time this tank would have exploded if put into the service for which it was intended. Naturally, it was replaced by one of standard construction.

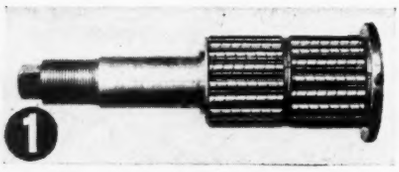


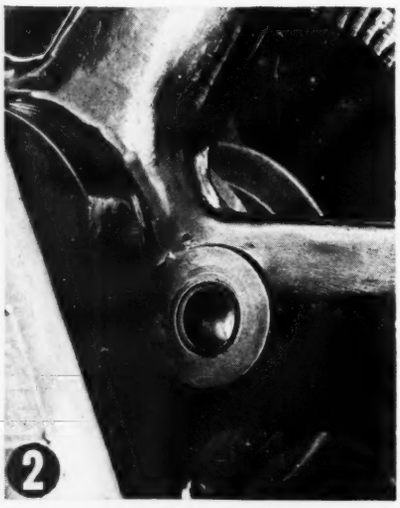
This air receiver with all seams riveted and brazed was bought for 150-lb service, but was found in dangerous condition because of faulty brazing

PRACTICAL AIDS TO OPERATION

Worn Pin Causes Governor Trouble

ON ONE OF OUR 200-KW ENGINES the governor failed to give its usual close speed regulation. The inertia bar of the governor is supported on a roller bearing on a pin, Fig. 1, held in a hole in a flywheel spoke, close to the hub. The sleeve on the pin on which the bearing runs extends beyond the end of the bearing and acts as a shoulder against which the pin can be tightened without jamming the bearing. After taking down the governor, we found that this sleeve, which is only ⅛ in. thick, had cut into the spoke about $\frac{1}{16}$ in., allowing the pin to wear the hole slightly out of round and causing improper action of the governor.





To correct the trouble we counterbored the hole ¼ in. deep, Fig. 2, into which we pressed a chrome steel ring with a bore that would make a good fit on the pin. Fig. 3 shows the ring in place. This ring serves the double purpose of truing up the hole and providing a substantial bearing for the pin. The unit has since run over 3 years without any indication of the old trouble.

Hanover, N. H. A L WATERMAN

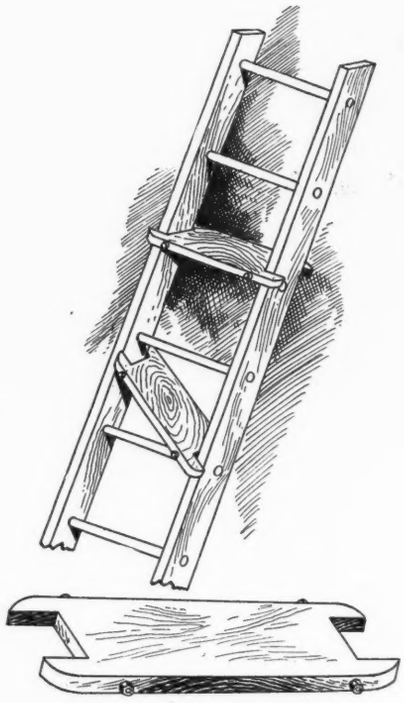
Sulphuric Acid in Motor Windings

CALLED IN TO INVESTIGATE why the stator windings failed in an induction motor driving a forced-draft fan on a kiln, I found evidence of sulphuric acid in the insulation. The windings were coated with soot and dirt, so I used a knife to remove some of it so that the insulation could be inspected. To my surprise the knife blade soon took on a light copper coating. Digging into the insulation showed it to be charred and the conductors covered with a moist substance that proved to be sulphuric-acid solution.

Checking up on the layout showed that soft-coal smoke from the kilns was being drawn into the motor room by the fan. Soot, which contained sulphur dioxide from the smoke, deposited on the winding. Then moisture combined with the sulphur to form acid in the winding.

We rewound the motor and impregnated the windings with an acid resisting paint. This, and a change in the blower intake to eliminate a large part of the soot getting on the windings, cured the trouble.

Trenton, N. J. R O CUMMINS



Detachable Tread for Ladders

ANYONE who has worked for a long time standing on the round rung of any ordinary ladder will appreciate this detachable wide tread. It's made from a piece of good hardwood notched at the ends to fit the ladder sides, and reinforced against splitting by a couple of bolts and washers near the notched end. The step is slipped on the desired rung by canting it at an angle and pressing it into place.

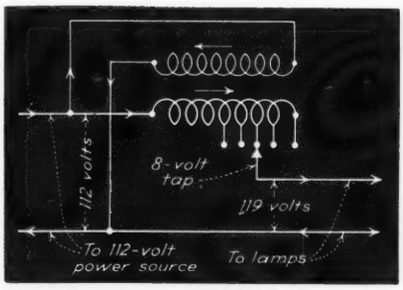
Be Sure of Field-Coil Polarity

WHEN ASSEMBLING GENERATORS and motors after repairing, watch out for wrong field-coil polarity. In one plant the engineer replaced a field coil in an 8-pole ac generator. After connecting in the coil he could not get the machine up to voltage.

A trouble shooter came in and found

that three adjacent field coils had the same polarity. He corrected the trouble by disconnecting the center coil of the three, which happened to be the new one, turning it through 180 deg and connecting it back into circuit. Checking field-coil polarity is a very simple matter, as explained on page 100, June POWER, but it must be done carefully.

Plainfield, N. J. H W HODGSON



Bell-Ringing Transformer Corrects Lighting Trouble

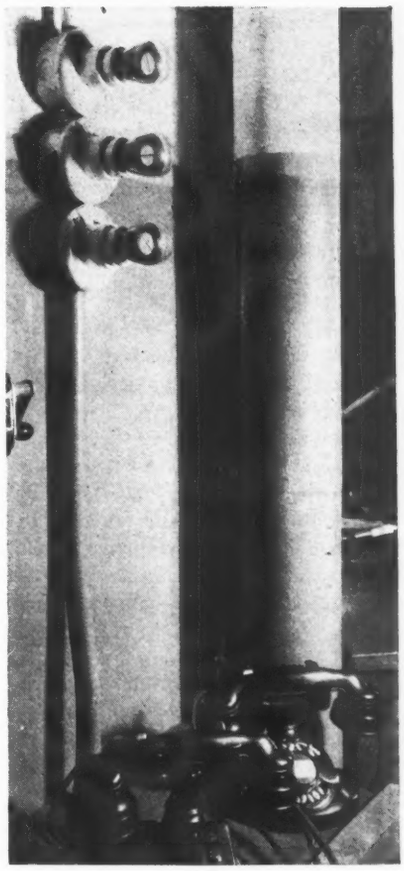
SOME TYPES OF LAMPS are quite sensitive to voltage changes, which makes it necessary to hold the potential near rated value at their terminals. We experienced this condition with five 40-watt fluorescent lighting units. When first installed, they had a tendency to flicker. A test with a voltmeter showed only 112 volts at the lamp terminals, where there should have been 120.

To correct this condition, we connected a 50-watt bell-ringing transformer in the circuit, as in the figure. Using the 8-volt tap on the transformer gave us about 119 volts at the lamps. The transformer does not heat excessively and I would not hesitate to add 3 or 4 more lamps to the circuit if necessary.

Ansonia, Conn. W T ESTLICK

Neon Lamp Indicates Which Phone Rings

THE ATTENDANT at the loud-speaking phone-system receivers on the elevator system at 40 Wall St, New York, N. Y., has 3 regular desk phones to answer in addition to 5 master loud speakers, each



master having 5 remote phones. To make it easy for the attendant to quickly identify each house phone when it rings, we connected a low-voltage neon lamp across the ringing circuit of each phone (See photo). When a phone rings the attendant looks at the neon lamps, sees which one lights, and immediately picks up the correct receiver.

New York, N. Y.
WILLIAM DEVAUGHN

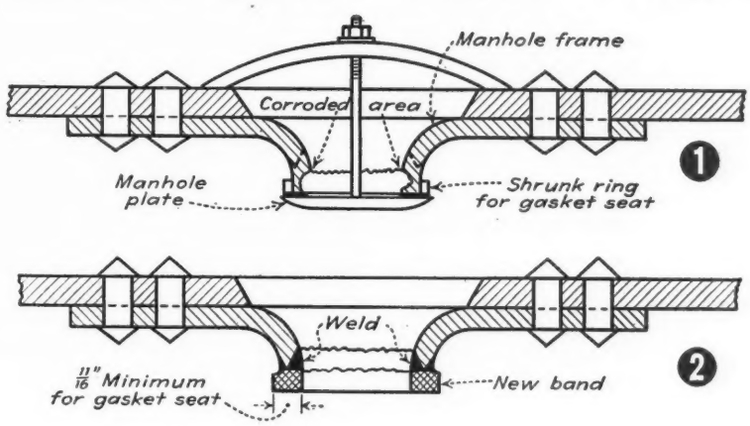
Welding Repairs Damaged Manhole Flange

EXTERNAL SURFACES of a flanged-in manhole frame may be damaged seriously by corrosion, usually caused by leakage past the gasket. Moisture contacting soot on the manhole-frame surfaces forms a sulphurous acid which deteriorates the metal rapidly, Fig. 1. This action often forms a vicious cycle, because the manhole flange is more easily distorted, and it becomes more difficult to maintain a tight gasket seat. Leakage is more frequent and extensive, and deterioration progresses more rapidly.

You can check this condition in its early stages by wire brushing the flange surfaces clean, painting them with an anti-corrosive paint, and being careful to obtain clean, tight gasket seats. When deterioration has progressed to where the manhole frame is weakened, and the gasket cannot be kept tight, repairs are necessary. A new manhole frame may be installed, or repairs made by welding, Fig. 2, may be cheaper and acceptable.

Cut the defective part of the flange off with an acetylene torch, and vee the outside edges to about 60 deg. Make a band of flange-quality boiler plate, $\frac{11}{16}$ in. thick for the gasket surface, to coincide with remaining section of the manhole frame. Machine the edge of this band square and smooth for the gasket surface, and make the outer surface to the same thickness as the manhole frame. The inner edge of the frame is then veed to about 15 deg. Have welding done by a certified welder using electric welding.

Chicago, Ill. C A ARMSTRONG



How to Remember Viscosity Scales

THOSE INTERESTED IN FUEL OIL for steam generation realize the effect viscosity has upon atomization. For industrial boiler plants, a grade of oil classed as No. 6 is generally used, but sometimes No. 5 is burned. Standard viscosities of both these oils are given in Seconds Saybolt Furol (SSF). When raised to the temperatures required for satisfactory atomization, the viscosity is given in Seconds Saybolt Universal (SSU).

A number of charts are available that show the relationship between the Furol and Universal scales, but an inspection of them makes it clear that for all viscosities above 40 SSF, the ratio between these values at the same temperature is almost exactly 10 to 1, that is, 100 SSF is practically 1000 SSU. Below 40 SSF,

if we deduct 1 from the ratio for each 10 seconds, we don't go far wrong. For instance, 30 SSF is in the neighborhood of 30 X (10–1) or 270 SSU, which is near enough for most practical purposes. This 10 to 1 relation is easy to remember, and is practically accurate.

Unfortunately, standard practice requires that viscosity classifications shall be made at different temperatures on the two instruments, namely, 100 F for Universal, and 122 F for Furol. It so happens that for the heavier oils, the viscosity is almost twice as much at 100 deg as it is at 122 deg.

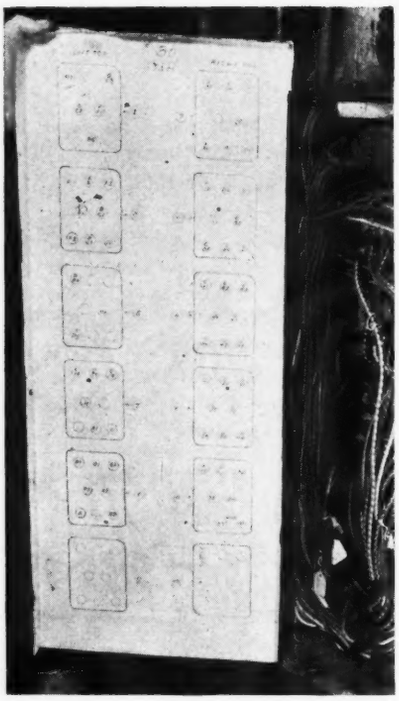
Fortunately, if we know the viscosity rating of any oil on one instrument, at a given temperature, we can easily find what it would be on the other at the same temperature, by applying the 10 to 1 rule. This is generally what we want to know. At the same time, it is well not to forget that an oil which is classed as 100 SSF would be classed as 2000, and not as 1000 SSU.

Bloomfield, N. J. J O G GIBBONS

Terminal Marking on Junction-Box Covers

TO CORRECT TROUBLE quickly on modern high-speed elevators, one must be able to locate wire terminals quickly and positively. We have solved this problem in the 70-story building at 40 Wall St, New York, N. Y., by marking the terminals on the elevator panel board and on the junction boxes.

We painted the inside of the terminal-box covers white, and then with India



ink laid out the terminal blocks (see photo) and marked the terminals according to the control marking and the color of the braid over the wire insulation in each circuit.

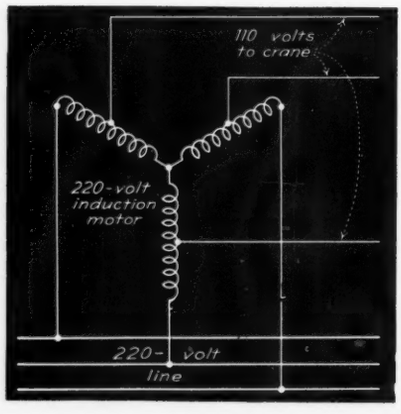
To make the record permanent, we gave the white paint a coat of clear varnish after the marking was completed. This permits us to go to a terminal box and identify immediately any wire on which we might wish to work. Having the color code marked on the covers of the boxes allows us to replace and connect in a cable without any testing.

New York, N. Y. WILLIAM DEVAUGN

Induction Motor as An Auto-Transformer

I WAS CALLED INTO A PLANT one day where a bank of transformers had failed. These supplied power to crane and machine-shop motors at 110 volts. Another bank of transformers provided power at 220 volts for the other motors in the plant. Without the crane, the plant could not be operated, so something had to be done while the burned-out transformers were being replaced, which would require several days.

The 220-volt transformers did not have 110-volt taps and the lighting transformers were too small for the load. Something else had to be tried. I found a squirrel-cage induction motor that had sufficient capacity to carry the load as an auto-transformer. This was connected to the 220-volt line in the usual way, and then I ran the 110-volt line to the middle point of each phase



winding as in the figure. The motor was operated from the 220-volt line without mechanical load, while its windings acted as transformers to supply power to the 110-volt circuit. This arrangement worked until the old transformers could be cleaned and repaired.

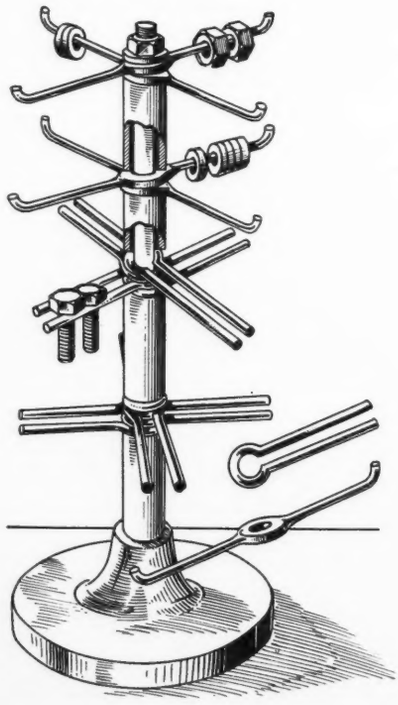
Plainfield, N. J. H W HODGSON

Chain Change Cures Hot Bearing

ONE OF OUR CHAIN-LUBRICATED BEARINGS, loaded on the top half and up near the ceiling where it cannot be inspected easily, started overheating. After trying all the usual remedies, including adding sulphur to the oil, we called in the manufacturers who were no more successful. We then installed a new bearing, but it also had fits of excessive heating.

Finally, someone got the bright idea that the chain might not be delivering sufficient oil to the bearing. We changed to a longer chain, made of links that look like short spiral springs, and this cured the trouble. This chain dips farther into the oil and has a greater carrying capacity than the one that we used originally.

Cleveland, Ohio B N SAWYER



Bolt and Washer Xmas Tree

THE BOYS AT THE PLANT call the rack, shown in the figure, a bolt-nut-and-washer Xmas tree. But it certainly keeps these small objects in view where they can be found in a hurry. This rack is quite simple to make from round rod and sections of pipe, details of which are all apparent in the drawing. It can be made in a size most suitable for your need. We have a large one that stands on the floor and takes anything from 1-in. nuts to spare special piston rod nuts 3-in. in diameter and corresponding sizes of large washers and bolts. One for

the bench serves as a general catch-all for small-size parts including bolts, nuts, washers, shims and gaskets.

Penacook, N. H. C H WILLEY

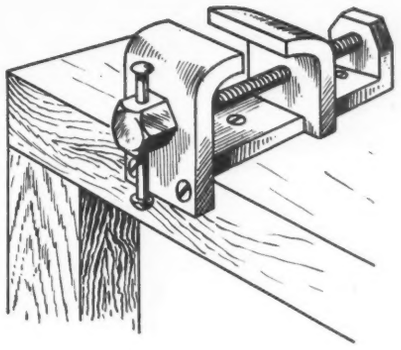
Checks Oil Quality With Millivoltmeter

ONE OF OUR TURBINE-GENERATOR BEARINGS became overheated. We thought that the trouble might be caused by shaft currents and so insulated the bearing pedestal. This seemed to cure the trouble, but in a few weeks it started again. We then took a sample of the oil at operating temperature, and put into it two electrodes, one of steel and the other of babbitt metal. A millivoltmeter connected to the electrodes showed a reading of ½ millivolt, indicating an acid condition. An oil-company representative was called in and the oil changed to one that would not give a reading on the millivoltmeter. This corrected the trouble and we had no more difficulty with the bearings.

Plainfield, N. J. H W HODGSON

When You Have Time, Make This One

THERE ARE PLENTY OF BENCH VISES on the market, but this simple 3-piece home-made one is made from flat-bar stock 2 in. wide and ⅝ in. thick, and is very handy for lots of light jobs. The



drawing shows its simple construction. The front jaw is secured to the bench, while the other one is operated by the common bolt screw, the moving jaw being notched to slide on the guide bar.

Boston, Mass. L W ROGERS

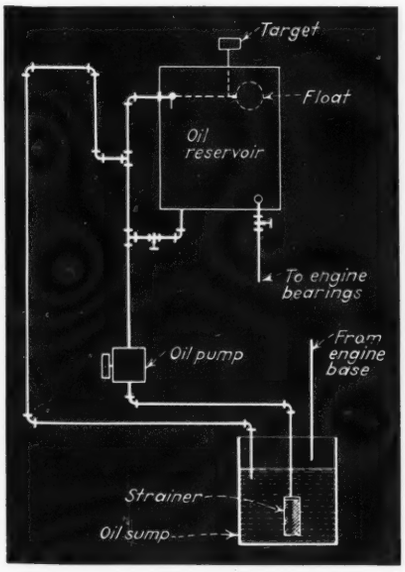
Improves Lubrication of Steam Engine

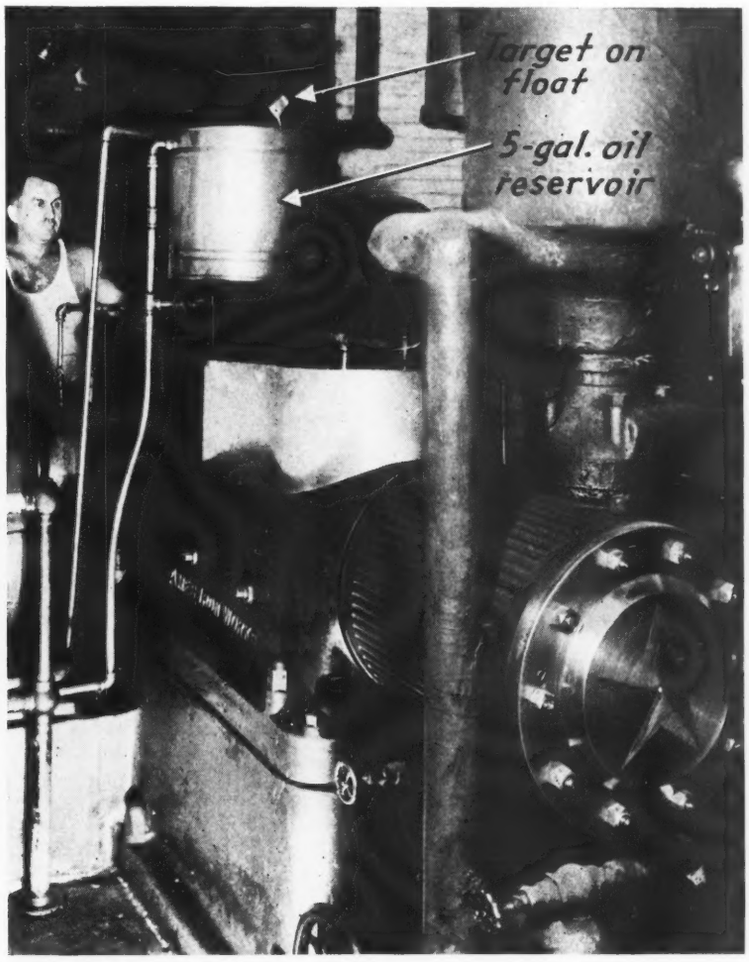
ONE OF OUR STEAM ENGINES was lubricated by a gravity system. As originally installed, the gravity tank held about 1 gal. only and it was also difficult for the operator to know when the tank was full. Because of the small capacity of the tank, it might empty without the operator knowing it, particularly at night when one man attended both boiler and engine.

To overcome these difficulties we put in a gravity-circulating system with a 5-gal. tank above the engine, as in the photo and diagram. A float valve controls oil flow into the tank. A target on the float shows above the top of the tank as long as it is full, and makes it easy for the operator to check the oil level from any part of the engine room. A loop in the return piping maintains a small head of oil on the float valve at all times without building up high pressure in the system. Overflow from the pump discharge and oil from the engine bearings returns to a sump from which the pump draws oil through a strainer.

The rotary oil pump is driven from the engine shaft by two round belts, either of which has sufficient capacity to drive the pump. If one belt breaks, the other keeps the pump in service until a repair or replacement of its mate can be made.

Riverdale, N. Y. ALEX GRAY
Chief Engr, Colored Orphan Asylum





READERS' PROBLEMS

Questions for Our Readers

Checking Stretch of Connecting-Rod Bolts

Question 1

HOW CAN WE CHECK *the stretch of connecting rod bolts in our diesel? Also, is it possible to find out if the bolt has been twisted by sledging up?*—KGA.

Cleaning Gage Glass

Question 2

WHAT IS A GOOD WAY *to clean a water glass on a low-pressure boiler without removing the glass tube?*—LCM.

SUITABLE answers from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.

Heating-Coils Return

Answers to Sept Question 1

The Question

AS SHOWN IN THE SKETCH, *our plant has a Hartford loop on return lines from heating coils. There is a condensate line directly from steam line to return line. I think that this loop retards water return to boiler and allows water to remain in heating coils thereby lowering my heat efficiency at heating coils. Can any* POWER *readers offer suggestions?*—WFC.

Hartford Loop

[*Many readers agreed that the Hartford loop was not responsible for WFC's trouble, and many prefaced their answers with a description of the theory of the Hartford loop. To save space and permit more answers to be printed, we have combined discussion of the loop—Ed.*]

THE HARTFORD LOOP was devised to eliminate check valves in cases where there is danger of water backing out of the boiler into the return line. This might happen, if, for instance, the main boiler stop valve was closed, or if all radiator valves were closed at the same time.

Under such conditions, pressure in the boiler would force water out of the return connection if a check valve or loop were not provided. The loop also prevents the possibility of losing water if the return line should break or leak while the boiler is under pressure. This, in turn, prevents possible cracking of cast-iron sections; the Hartford loop was originally designed for sectional boilers.

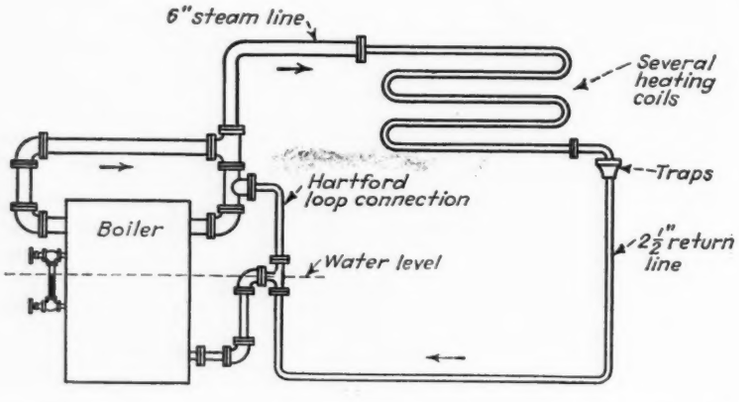
Suggests Pump

WHEN EXCESSIVE FOAMING AND PRIMING occurs in a boiler, the effect is often much the same as if return water were backing up, but probably WFC has assured himself that this is not the case.

There will, of course, be some drop in pressure on the steam lines, and even when the radiator traps are discharging, pressure at the far end of the return line will be less than that on the water in the boiler, so that if any of the heating coils are not far above the water line, there may be difficulty getting them clear of condensation.

As the steam main is 6 in., apparently there is a fairly heavy load, and the pressure drop on the main and branches may be considerable, especially if the coils are a long way from the boiler.

If WFC finds that there is not enough elevation between the traps on the coils and the boiler water line, I suggest that he install a condensation return pump, installing the pump in a pit if necessary to provide a good return head. Condensation will then flow to the receiver by gravity and be pumped into the boiler. A pump is not, of course, as simple as a gravity return, but it will often save a lot of trouble.



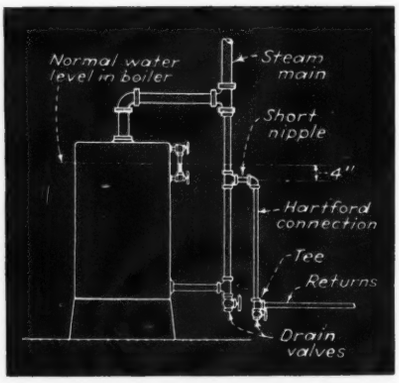
The sketch shows an absolutely closed system with a wet return; I assume, however that provision has been made for venting air. This is important and some of the trouble might be due to inadequate air elimination.

Bloomfield, N. J. J O G GIBBONS

Would Lower Loop

THE SKETCH SHOWS a standard Hartford loop connection, which is slightly different from WFC's. The point where the returns enter the loop is about 4-in. below the normal water level in the boiler.

If this is a low-pressure system, it would be advisable to install air-vent or vacuum valves, depending on whether it is a pressure or a vapor system. This would rid the system of air, when starting up. If it is a pressure system, it may be that several coils have their returns connected to one trap. This would produce short-circuiting



and lower heating efficiency. If all coils are sufficiently above the water level of the boiler, there should be no difficulty in the use of a standard Hartford connection.

A long, wet return with numerous fittings should be avoided. Excess friction tends to produce sluggish action and may cause wide variations in boiler water level, particularly when starting up. If traps are proper type for return line service, and each coil is trapped, a vacuum pump in the return main would insure maximum efficiency in the coils and proper return of condensate. In any event, the Hartford loop should be changed to match the accompanying sketch, and a drain valve for cleaning out the lines should be installed as shown.

Ansonia, Conn. W T ESTLICK

Would Lower Tee

WFC'S TROUBLE might be overcome by lowering the Hartford connection to a level in line with the bottom of the water glass. This would insure maintaining a column of water between boiler and return line, under normal operation.

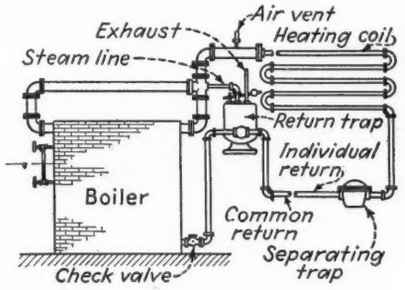
At the present high level, it is just pos-

sible that on occasion air may be become locked in the line between the Hartford loop and the boiler. Under such circumstances, the condensate return might become sluggish. By lowering the tee connection indicated by the sketch, it is possible that the trouble may be overcome and at the same time the safety features of the loop retained.

Sault Ste. Marie, Ontario J HARDIE

Use Return Trap

THE SKETCH SHOWS how I would replace the Hartford loop with a return trap above the boiler. I would also add an air-vent



trap in the steam line. Steam traps on the coils would dump into the return trap, which would, in turn, dump into the boiler.

Wilmington, N. C. G G AVANT

Also Return Trap

WFC MIGHT OBTAIN better all-around operating results by installing a direct-return tilt trap. Traps of this type will deliver water to the boiler regardless of temperature, will not steam bind, and will operate economically.

Moosejaw, Saskatchewan H C YEO

Coils Too Long?

IF WATER COLLECTS in the lower part of WFC's heating coils, it is not due to the Hartford loop unless it is clogged with sediment. The trouble probably comes from coils that are too long or supply piping that is too small for the pressure carried, or both.

With wet returns, as shown in the sketch, water will rise in the returns to a point determined by boiler pressure and pressure at the return traps. Suppose we start off with a boiler pressure of 2 lb g. Water will rise in the returns to a point 4.6 (2x2.3) ft above the boiler water level. Let's call this point *A*. It will rise higher if there is a partial vacuum at the traps. How much higher depends on how much vacuum (about 1.13 ft per in. of vacuum). Then, if the traps are not that much higher than point *A*, water will rise in the coils to that height (assuming that the traps are at the outlets of the coils) and the heating capacity of the coils will be cut down.

WFC has several ways of determining whether there is water in the coils. The simplest way is to attach a thermometer to the outside of the lowest pipe of the coil, near the return outlet, using a small wad of putty and some friction tape. After the mercury stops rising, read the thermometer. If it shows much below 212 F, there is surely water. Or, WFC could connect a vacuum gage at the coil outlet and from its reading calculate the height of the water above point *A*. Still another way is to connect a boiler water glass to one of the coil return headers.

If the coils give all the heat required, WFC need not worry about water affecting their heating efficiency, as this is something you don't get for nothing. How much efficiency you want depends on how much you are willing to pay for it. On the other hand, if WFC isn't getting enough heat, he might try increasing the boiler pressure, or dividing his coils into smaller units with generous supply lines to each. Or he might try running larger supply lines to the present coils.

San Diego, Calif. C A LEQUESNE

Check Return Piping

IT HAS BEEN FOUND that the size of the equalizer pipe which connects the steam space of the boiler to the highest part of the loop is an important factor and is related to the size of the boiler approximately as follows: for boilers with a grate area up to 5 sq ft, 1½-in. pipe should be used; for grate areas up to 15 sq ft, 2½-in. pipe, and for grates larger than 15 sq ft, 4-in. pipe.

Hartford loops are not usually installed in one-boiler plants unless the boiler has stop valves on the main steam line. Since the boiler in question does not appear to have such valves, it seems doubtful whether a loop or check valve is required. The piping arrangement is simple and should permit a free flow of condensation to the boiler if the condition of the return lines does not retard it in any way.

Various parts of the heating systems are suspected of causing trouble when the real source may be poor condition of parts of the return piping, which may have sagged or become sufficiently disarranged to destroy proper pitch. Pockets in which air or sediment may collect sometimes form, and there is even the possibility that considerable leakage may go undetected in some out-of-the-way place. Any of these conditions would, of course, prevent proper return of condensation to the boiler and would result in unsatisfactory service.

Jersey City, N. J. I S CHAMBERLAIN

Blames Equalizer

IF THE HEATING COILS are above boiler water level, the loop will not retard flow of condensate to the boiler. It is apparent that the trouble lies either in the traps or the equalizer connection from the steam main to the loop. Traps should be inspected and any defects remedied. If the traps are not bypassed, it would be advisable to have bypass connections made.

If the traps are satisfactory, the trouble may lie in the equalizer, which may be connected to the wrong side of the loop. The equalizer should be reset to connect with the return header at the bottom of the boiler, leaving the Hartford loop free of any connecting piping.

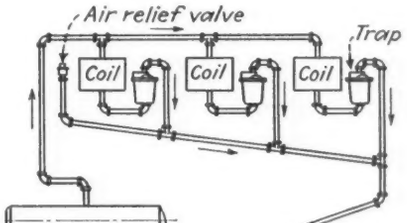
Unless the boiler is a cast-iron sectional unit, the loop can be dispensed with, but before doing so, check all steam risers and note the drop in the condensation returns, in other words, see that the piping sets for a free flow from coils to boiler.

Grand Rapids, Mich. J M GORRIE

Check Static Head

STEAM TRAPS on a closed gravity-return system are entirely practical if the available static head between the lowest heating coil and the water line in the boiler is greater than the steam pressure ordinarily carried. Also, an air relief valve must be located at the high point of the return line.

To clarify the discussion, refer to the diagram, which shows an actual installation of this sort. Maximum pressure carried is 10 lb. The lowest heating coil is approximately 30 ft above water level in the boiler. With 10-lb pressure on the boiler, height of the water leg in the return



pipe will be approximately 23 ft. If additional condensate accumulates in the return line, static pressure in the water leg will exceed boiler pressure, with the result that the check valve will open and admit water to the boiler.

The air valve at the high point of the return line can be any ordinary shut-off valve or, better yet, any good thermostatic vent valve.

To insure successful operation of a system of this kind, the separating steam traps used on the various steam coils or radiators must be in first-class mechanical condition and absolutely prevent any blow-through of steam to the return line. Leaky traps will tend to equalize the pressure, which, of course, would cut down capacity of the traps to a point where water or air might back up in the heating coils.

Three Rivers, Mich. T H REA

Return Connection

BY NO MEANS does a properly installed loop retard return of condensate, but most likely WFC's difficulty lies in the position of the present return-line connection. Assuming the boiler level is very unstable or low, then steam might flow in both directions, causing accumulation of condensate in the heating coils. In order to maintain gravity circulation at all times, the return line should be connected *horizontally*.

Operating performance could be further improved by installing a steam trap, where the 6-in. line reduces, with a ¾-in. drip line connected to the return line at a convenient point. I also suggest installation of air eliminators or quick vents and parallel-connected steam traps at the 2½-in. return line. Also bottom blowoff or drain valves

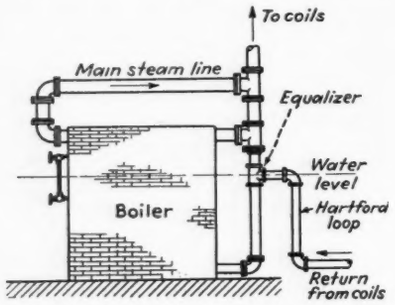
for periodic cleaning of sediment in return lines and inlet connection must have been overlooked. Sediment at these points will retard circulation.

Huntington, W. Va. CARL BACHMANN

Change Header Hookup

I SUGGEST that WFC change the boiler header hookup. When dealing with boilers having steam outlets at the sides instead of on top, insure proper drainage of water from the header or else, as in WFC's case, wet steam will be sent to the heating coils.

The sketch shows a header hookup which



permits steam from both outlets to travel in the same direction, minimizing turbulence. Steam velocity will carry water to the end of the header and dry steam will go up the main. As the plant is now hooked up, water cannot go through the Hartford-loop connection as steam coming out of the back outlet forces water up into the main.

Riverdale, Md. A A KORAB

Need More Head

IF CONDENSATE REMAINS in the heating coils, there is evidence that there is not enough head available to force water back to the boiler. There should be enough head in the return line, below the trap, to overcome friction in the return and to make up for pressure loss in the heating coil so as to keep water from backing up.

The difference in height between the trap and the water level must be at least equal to the difference between pressure in the steam main and pressure in the return line, ahead of the trap. If it is not, then water will back up into the coil in order to make the difference in height large enough. WFC can overcome this trouble by rearranging the coil or increasing pipe sizes if the coil cannot be relocated.

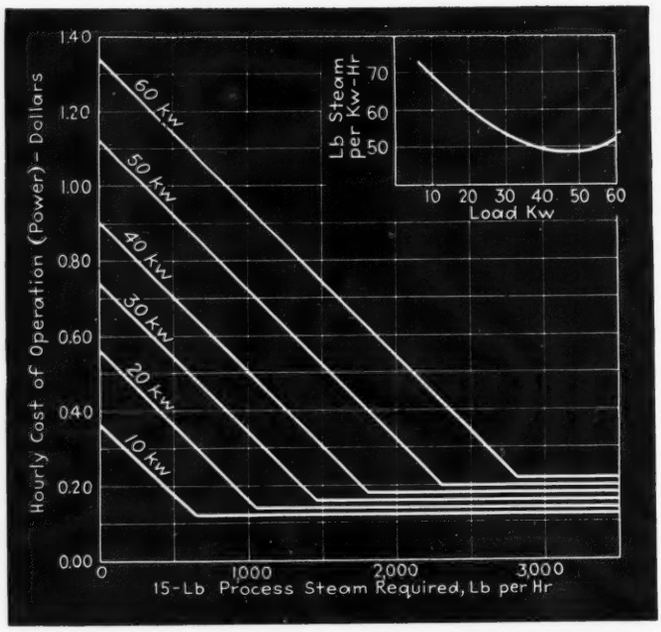
University, La. G F MATTHES

Will Engine Pay?

Answers to Sept Question 2

The Question

WE ARE CONSIDERING *the purchase of a 60-kw engine-generator set to supply our daytime factory load from our existing 125-lb pressure boilers. We have to carry 125-lb for a small part of the process but most of the steam is used at 15 lb g. We are now buying hydro power averaging about 3¢ per kwhr including service charge.*



Coal is $6.30 a ton. Should we spend about $3000 for the engine installation?—SS

Cost per Kwhr

THERE ARE SEVERAL IMPORTANT FACTORS missing in the information given by S S. To figure the cost per kwhr generated, it will be necessary to assume information.

Thus, assuming the following conditions, cost per kwhr is:

Coal (as received)	14,500 Btu
Boiler efficiency (over-all)	72%
Lb of steam used by engine per kwhr, inc. line and trap losses	36
Total kwhrs per yr (40 hr/week, 50 weeks/yr, 60-kw load)	120,000
Btu's absorbed by blr (14,500 × .72)	10,440
Lb of water evap., actual, as fired (10,440 ÷ 1186.9 = total heat in 1 lb of steam at 125 lb pressure)	8.8
Lb of coal/kwhr (36 ÷ 8.8)	4.09
Cost/lb coal (6.30 ÷ 2000)	$0.00315
Fuel cost/kwhr (4.09 × 0.00315)	$0.01275
Fixed charges on $3000 @ 15%, per kwhr (3000 × .15 ÷ 120,000)	$0.00375
Oil, packing, waste, etc (100 ÷ 120,000)	$0.00088
Total cost to generate a kwhr	$0.01738
Cost to purchase a kwhr	$0.03000
Saving by gen/kwhr	$0.01262
Total saving /yr (120,000 × .01262)	$1514.40

It is assumed that it will not be necessary to increase the operating force.

Waterbury, Conn. F W CARTER

Simple Procedure

NOT KNOWING THE STEAM RATE of the engine which is under consideration, and with no information as to the magnitude, duration and coincidence of power and process steam loads, it is not possible to give a definite answer to this question, but it is possible to indicate a simple procedure by which SS can solve this problem to his own satisfaction.

1. Obtain steam consumption curve for engine under consideration (such as shown in upper right hand corner of chart). For a new engine, this can be obtained from manufacturer; for a used engine, a lot of good judgment must be used in allowing for piston and valve wear.

2. Construct chart similar to one shown.

3. Tabulate number of hours per year at each power and process steam load.

4. Check cost of operation thus obtained against cost of purchased power.

5. Savings (if any) will indicate desirability of purchasing engine, final decision naturally resting with plant owner.

In chart above, steam chargeable to power = 5 lb per kwhr plus exhaust steam wasted. Steam cost = 40 cents per M lb (fuel only). Tube and minor repairs = 10 cents per hr of operation. No extra labor charges. No fixed charges.

Rochester, N. Y JULIUS BRODSKY

How Much Purchased?

PERHAPS THE MOST IMPORTANT QUESTION, and one to which insufficient consideration is often given, is how much electric power shall we have to purchase in any event, and what effect will reduced demand have upon the rates?

My experience has been that unless you have a large plant, with standby equipment and overtime service, quite a lot of current has to be bought, sometimes at rather high rates. For instance, the office generally requires some light after factory hours. Then too, how about the boiler room, toilet and watchman's lights? There should also be some kind of breakdown service. This does not mean that it would not pay to put in a generating set. S S can probably find answers to the above himself, but some answer must be given before we can reach an intelligent decision as to what action should be taken.

Bloomfield, N. J. J O G GIBBONS

Engine Will Pay

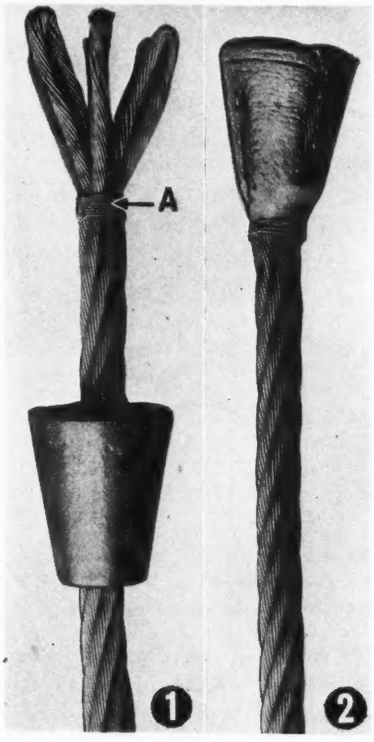
THE PRINCIPLE of installing an engine-generator set, whereby the engine acts as a reducing valve and generates byproduct power, is fundamentally sound. The actual saving possible is estimated on the

(*Continued on page* 152)

ARGUMENT CORNER

Another Way of Socketing Wire Rope

THE METHOD SUGGESTED on pages 111 and 112, August POWER, for socketing wire rope is O K when properly done, but I prefer the turned-in method shown in the photos. All elevator mechanics are familiar with this method and it does not require any special equipment out on the job. The rope is



seized as in the straight method, the socket pushed on over the rope end, after which end seizing is removed.

Then, the strands are opened back to a seizing *A*, Fig. 1, just outside the small end of the socket basket. The hemp core is then cut out and the ends of the strands turned in, after which the basket of the socket is pulled up tight against the turned-in ends and poured full of babbitt.

If the job is done correctly, the babbitt and ends of the strands look like Fig. 2. Even if the babbitt is not properly poured, the turned-in ends of the strands will prevent the rope from pulling out the socket. This is a real safety feature and is why the turned-in method of putting sockets on wire rope is preferred by many engineers.

Falls Church, Va. J C RUNYON

Practical Pointers on Artificial Respiration

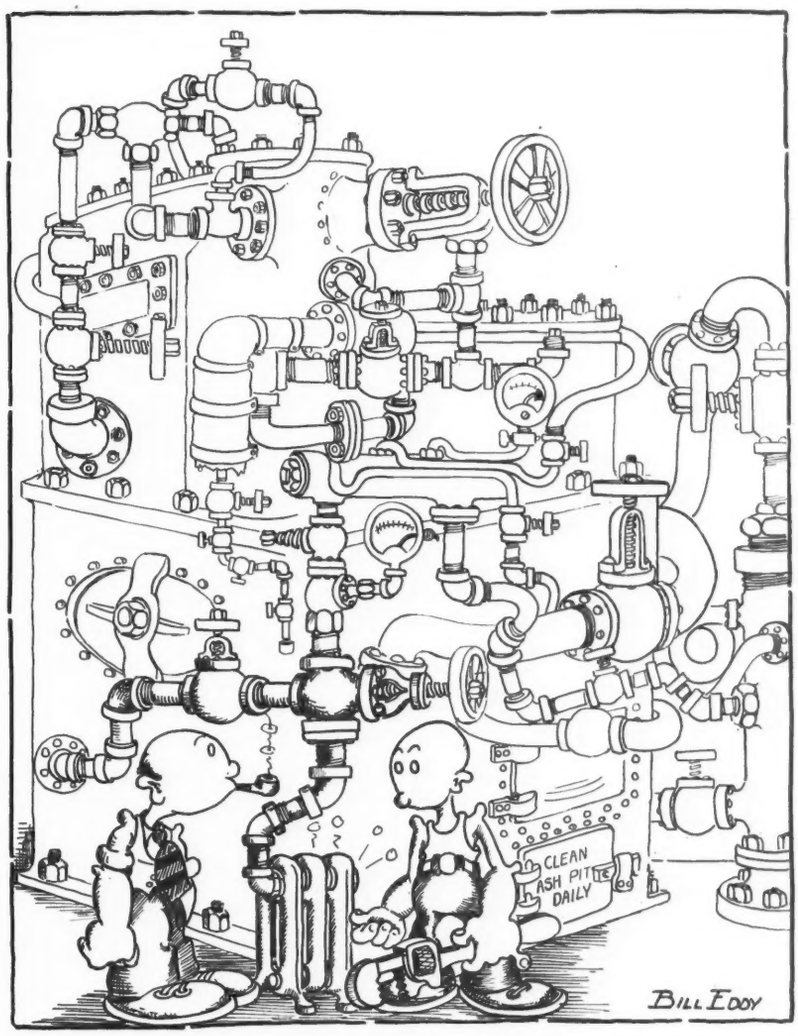
Last month's article on "How to Apply Artificial Respiration" was a swell job, but several parts of the method described struck me as hard to remember. And when somebody needs artificial there's no time to look up a clipping.

Here's the sort of thing I mean: They give five counts and say "space at 1-second intervals." I'd almost bet that not one man in ten can count 60 seconds to himself and come out even close to a minute. The silent counter counts too fast. The Boy Scouts taught me how. Instead of counting "One, Two, Three" and so on, count "One thousand one, one thousand two, one thousand three," and so on, *out loud*, at normal talking speed. That "one thousand" stuck in there will give almost exact spacing. That's vitally important in getting the proper number of cycles—12 to 15—per minute.

But most Scouts don't count at all. They repeat a little singsong, "*Out* goes the bad air, *in* comes the good," pushing down on the "out," relaxing on the "in." Try it—you'll find it takes almost 5 seconds and gives a 12-time-per-minute cycle.

Three other small but unimportant points are these: The man in need of resuscitation may have a half-swallowed chew in his mouth. Start artificial respiration, but if it doesn't make the air pass in and out, have somebody check to see about the chew—or cleaning the mouth of any other foreign object (while you keep right on pumping). And if he has a wound that doesn't stop bleeding—a severed artery or vein—have somebody stop that.

And when you put hot objects around the victim to keep him warm, be sure they aren't too hot—an unconscious man can't kick even when he's seriously burned. GEORGE EDWARDS



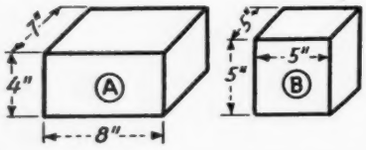
"But Mac, is it practical?"

How to Figure Volumes

By Phil Swain

Areas and surfaces were covered in July, August and October. Here are handy rules for volume, including short cuts

RECTANGULAR SOLID

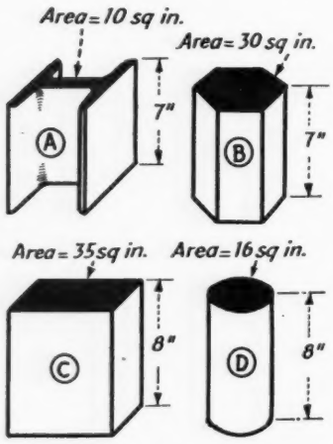


Rule: Area = product of three dimensions.

Ex: Vol of *A* = 4 in. × 7 in. × 8 in. = 224 cu in.

Vol of *B* (cube) = 5 in. × 5 in. × 5 in. = 125 cu in.

CYLINDERS



Note: Strictly, *A*, *B*, *C* and *D* are all "cylinders". *D* is a special case, a "right circular cylinder". In the general case, a cylinder is *any* body of uniform cross section, such as any kind of bar stock (round, square, hex, flat) or any rolled section (I-beam, channel, angle, etc).

Rule: Volume of any piece of uniform section (sawed square) = area of section × length.

Ex: Vol of *A* = 10 sq in. × 7 in. = 70 cu in.

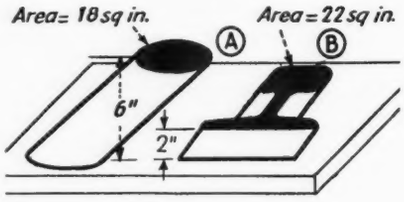
Vol of *B* = 30 sq in. × 7 in. = 210 cu in.

Vol of *C* = 35 sq in. × 8 in. = 280 cu in.

Vol of *D* = 16 sq in. × 8 in. = 128 cu in.

CYLINDERS SAWED ON SLANT

Rule: If any piece of uniform section is sawed on a slant with both ends



parallel, volume = area of one sawed end × length *between flats.*

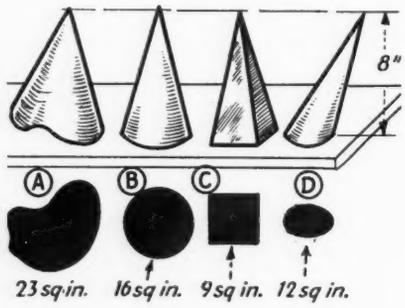
Note 1: Distance between flats can be measured on a surface plate as shown.

Note 2: Area of sawed end (when sawed on a slant) is greater than ordinary cross-section area.

Ex: Vol of *A* = 18 sq in. × 6 in. = 108 cu in.

Vol of *B* = 22 sq in. × 2 in. = 44 cu in.

CONES



Note: *A*, *B*, *C* and *D* are all cones. The usual "cone" *B*, a right circular cone, is merely a special case.

Rule: Volume of any cone = 1/3 × height × area of base.

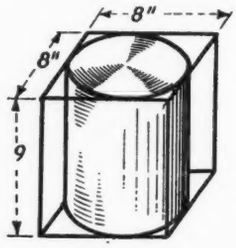
Ex: Vol of *A* = 1/3 × 8 in. × 23 sq in. = 61.3 cu in.

Vol of *B* = 1/3 × 8 in. × 16 sq in. = 42.7 cu in.

Vol of *C* = 1/3 × 8 in. × 9 sq in. = 24 cu in.

Vol of *D* = 1/3 × 8 in. × 12 sq in. = 32 cu in.

RIGHT-CIRCULAR CYLINDER



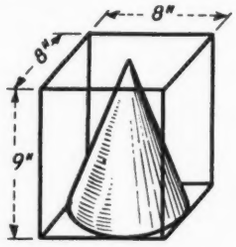
Rule: Volume of right circular cylinder = 78.54% of volume of rectangular solid it fits into.

Ex: Vol of rectangular solid = 8 in. × 8 in. × 9 in. = 576 cu in.

Vol of cylinder = 576 cu in. × 0.7854 = 452.39 cu in.

Note: Also, area of a circle = 78.54% of square it fits into.

RIGHT-CIRCULAR CONE

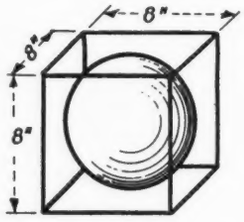


Rule: Volume of right-circular cone = 26.18% of volume of rectangular solid it fits into.

Ex: Vol of restangular solid = 8 in. × 8 in. × 9 in. = 576 cu in.

Vol of cone = 576 cu in. × 0.2618 = 150.8 cu in.

SPHERE



Rule: Volume of sphere = 52.36% of volume of cube it fits into.

Ex: Vol of cube = 8 in. × 8 in. × 8 in. = 512 cu in.

Vol of sphere = 512 cu in. × 0.5236 = 268.08 cu in.

HOW TO APPLY ARTIFICIAL RESPIRATION

II—Blanket Wrapping

GENERAL INSTRUCTIONS for applying artificial respiration, in cases of electrical shock and gas poisoning, given on these pages last month, stressed the vital importance of keeping the victim warm. A method of wrapping the victim in a blanket, without interrupting respiration, was mentioned. Here's the way it's done:

1. **Spread blanket at one side of victim and roll tightly. Operator continues applying artificial respiration in normal way until blanket is about three-quarters rolled**

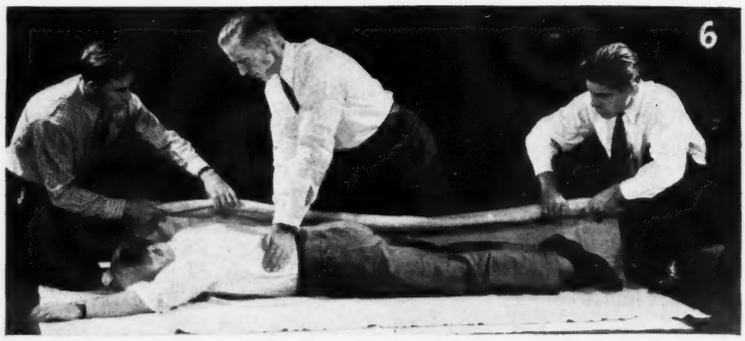
2. **Operator shifts to position at side of victim and continues applying prone pressure, without interruption, from that position. Assistants bring rolled portion of blanket close to victim's body**

3. **While operator is relaxed between pressure applications, the assistants roll the victim as shown, thrusting the rolled portion of the blanket under the body**

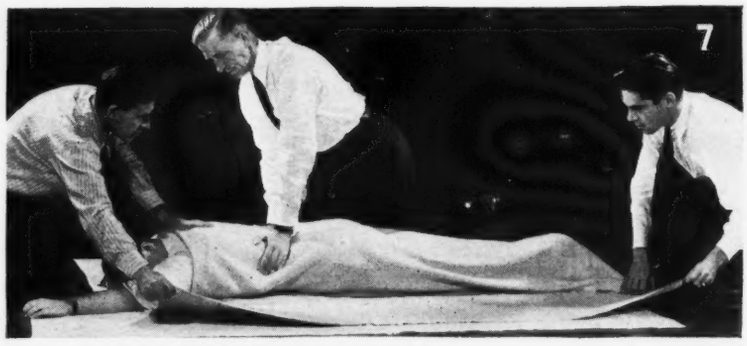
4. **The victim is allowed to fall back on the rolled portion of the blanket, and the operator again applies pressure, from the side position**

5. **When the operator resumes the relaxed position after applying pressure, the assistants roll the victim the other way, drawing out the rolled portion of the blanket on the far side**

HOW TO APPLY ARTIFICIAL RESPIRATION



6. They hold the rolled portion of the blanket ready as shown, while the operator again applies and releases pressure



7. In the intervening rest period, the assistants covered the victim with the far side of the blanket. The operator is shown applying the next cycle of pressure and release

8. With the operator again resting between pressure applications, the assistants cover the victim with the remaining part of the blanket, from the near side

9. With the victim completely covered, the operator resumes the more effective straddle position and continues applying and releasing pressure

Pictures posed in McGraw-Hill Studios by B W Byrnes and A E Erickson, Supervising Instructors, Dept of Resuscitation and Related Activities, Consolidated Edison Co of N. Y., Inc.

This series of operations looks, and is, simple, but takes close cooperation between operator and assistants to avoid any interruption of the smooth rhythm of respiration. During the entire operation, the operator must strive to maintain an even 12-15 pressure cycles per minute. Counting aloud, as described last month, helps the operator, and helps the assistants to keep in step with him. Note that all steps handled by the assistants, after the first two preliminary steps, are carried out while the operator is in the relaxed position. This means during the counts "Four" and "Five".

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AIEE Considers Industrial Power Problems

WITH THE ANTHRACITE-COAL REGION of Pennsylvania as background, the American Institute of Electrical Engineers held its middle-eastern district meeting and student-branch conference in the Hotel Casey, Scranton, Pa., October 11–13. Several of the papers presented were naturally devoted to problems of the coal-mining industry.

An opportunity was provided for members and guests to visit the Marvine anthracite-coal mines of the Hudson Coal Co. This trip included inspection of the immense underground pumping project, one of the largest coal-mine pumping stations in the world, with a total capacity of 32,000 gpm, against a total head of 270 ft. The equipment in this plant consists of eight large centrifugal pumps driven by 300 and 500-hp motors. Other trips included a visit to the Scranton steam plant, the Wallenpaupack hydroelectric plant, the Hazard Insulated Wire Works, and to the International Correspondence Schools.

Mercury-Arc Rectifiers

Wednesday morning's session was devoted to power applications in the coal-mining industry. Although mercury-arc rectifiers at present constitute only a small part of the total installed capacity of ac-to-dc conversion equipment in coal mines, D E Renshaw pointed out that in the past three years 21 rectifiers of a total rated capacity of 8100 kw had been placed in service in 15 coal mines. Considered alone, this would not be important, but since these rectifiers exceeded in number of units and capacity other forms of new conversion equipment installed in the same period, a definite trend toward the use of rectifiers is evident.

After describing the several installations made, and how some minor troubles experienced with them were overcome, Mr. Renshaw summarized the three years' experience in the application and operation of rectifiers in coal-mining industry, combined with many years of experience in other industries, as follows:

1. Rectifiers are at least equally reliable as other types of conversion equipment.

2. For equipment of equal service capacity for mining conditions, the initial cost of a rectifier will be approximately equal to or less than that of rotating conversion equipment.

3. Operating cost of a rectifier, including maintenance and cost of power, will be less than that of rotating machines, except where power-factor correction is of considerable importance.

4. Where additional power-factor corrective equipment is necessary, a motor generator or a rectifier with capacitors may be the preferred type of equipment.

5. An analysis of local conditions, taking into account required service capacity, hours of service per day, power cost and power factor is necessary to determine which type of conversion equipment is most advantageous.

Other papers at this session included one on "Electric Power Supply to the Anthracite-Coal Industry," by G E Northrup and "Application of Electric Power in the Anthracite-Coal Industry," by W H Lesser.

At the Wednesday afternoon session, G A Caldwell outlined the principal agents detrimental to the continued performance of electrical equipment in the steel industry, such as conductive dust, abrasive dust, corrosive fumes, water and steam, radiated heat, and high ambient temperature.

While standard electrical equipment operates for a limited time exposed to the elements just mentioned, failure in a very short time would be expected with certain combinations. If standard equipment is not able to withstand the conditions, special designs can be used or suitable buildings or inclosures provided.

On some installations, filtered air from outside the room is blown through the machine and into the motor room, from where it is discharged through room ventilators or other openings. Motor-driven blowers and mechanical filters are used to filter the air. With these the air is not cooled, and in warm weather the motor-room temperature may become uncomfortably warm for the attendants. More recent installations, therefore, cool and recirculate the ventilating air through the machine.

Small auxiliary motors are frequently used where they should be ventilated. A newly developed electrostatic filter has been used to provide clean air to such motors. This unit is more effective than the mechanical filter as it will remove the smallest carbon-brush particles and even smoke from the air.

The advantage of Class B insulation in dc motors for heavy-duty service, such as steel-mill auxiliary drives, electric shovels, dredges, hoists, cranes and oil-well drilling rigs, were presented by F A Compton Jr. In such installations, it is important that dc motors have winding insulation that will give long life and trouble-free service. This is also especially true of some auxiliary steel-mill drives, as well as on electric shovels and gold dredges, where a few hours' delay due to insulation failure may cause a loss equal to many times the original price of the motor.

Class B insulation, as applied to dc motors covered by the paper, consists of either mica or felted-asbestos conductor insulation and mica ground insulation with an outside casing of asbestos. Fiberglas insulation is sometimes used in place of asbestos. The principal advantages of Class B insulation over Class A were said to be the ability to withstand high operating temperatures for long periods, greater me-

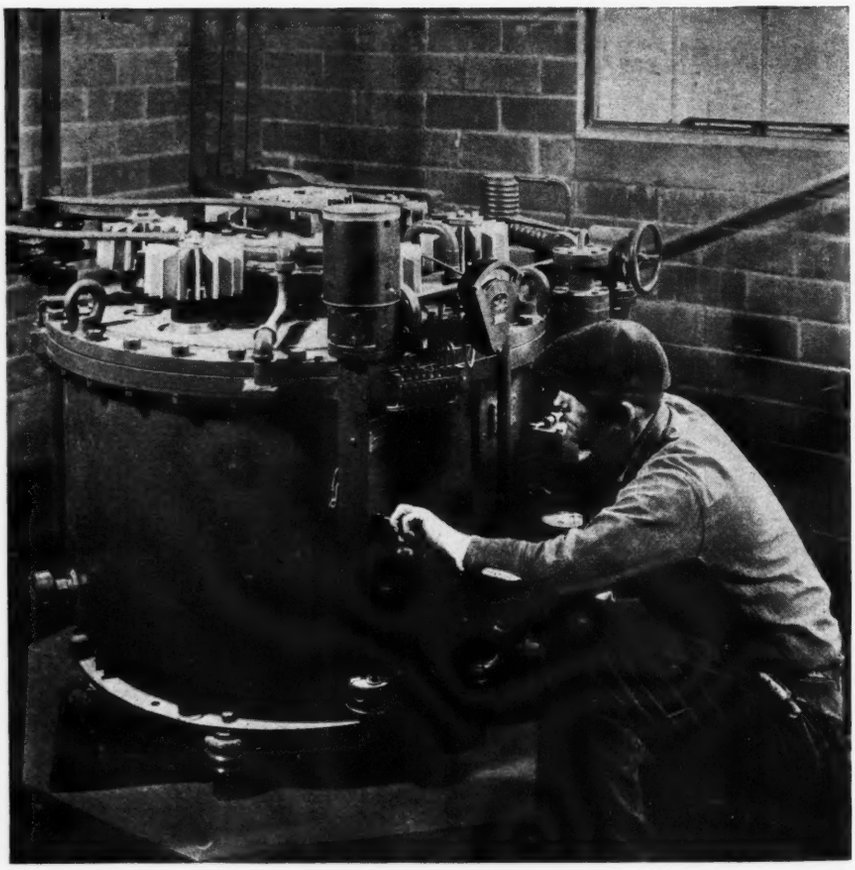
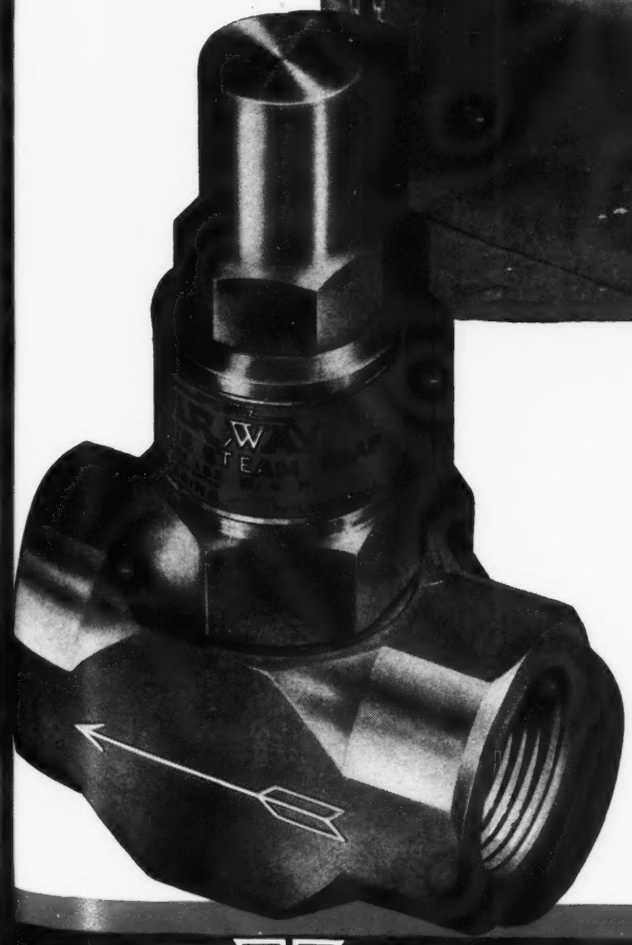


Fig. 1—This installation at Pittsburgh Coal Co. marked beginning of recent trend towards application of mercury-arc rectifiers to coal-mining service

Now 164 ~~93~~ YARWAY IMPULSE TRAPS at

LEE of Conshohocken Tires

Yarway Trap and Strainer installed on Rubber Calender. This ¾-inch Yarway Trap (weight 18 oz.), will discharge 1290 lbs. of condensate per hour at 100 lbs. W.S.P., and eliminates air binding.



When you ride on Lee Tires—think of the Yarway Impulse Steam Traps on vulcanizers, presses, calenders, heaters, etc., making these great tires. For Lee has standardized on Yarways.

Yarway Traps are the biggest little thing in profitable operation of steam equipment of all kinds because their quicker heating and greater sustained heating efficiency speed production and save fuel. And when you consider that their purchase is usually no more than the cost of repairing an ordinary trap—why not get Yarway performance for *your* money?

Install a Yarway Impulse Trap or two and let them prove what they can do for you. See how its small size saves space. How its light weight and straight through piping make installation easy. How its unique design, with only one moving part, and its rugged bar-stock construction, cuts maintenance costs. Then too, there is no need to change valve or seat for widely varying pressures.

A nearby Mill Supply Dealer handles Yarway Traps and will be glad to serve you. Or write for Catalog T-1734.

YARNALL-WARING COMPANY, 100 Mermaid Avenue, Phila.

YARWAY IMPULSE STEAM TRAP

chanical strength of mica, and superior moisture resistance of Class B mica-insulated coils compared to Class A coils.

Mr. Compton points out that many applications are known where Class B insulated motors and generators gave long and satisfactory service where their peak temperatures exceed 200 C, and the average operating temperatures 150 C. Because of this, he feels that a higher temperature rating than the present AIEE 75-C rating is justified.

A guide for selection of distribution-transformer sizes as determined by load-cycle requirements, based on the ASA proposed "Guides for Operation of Transformers," was given by M F Beavers. The ASA proposed loading guide incorporates curves for the short-time loading of 100-kva and smaller distribution transformers, below 15,000 volts, and for 500-kva and smaller network transformers. The loading guide, Fig. 3, consists of curve *A* for time durations below five minutes, which assumes the load to be of an emergency nature, such as a short circuit, and to follow full load. Curve *B* for duration of 5 min. and above, assumes a recurrent load, such as the daily load cycle, and to follow no load or excitation conditions. Loading conditions on which the other curves are based are given in the table.

In Mr Beaver's opinion, it is very desirable to use ASA recommendations as a basis of a loading study. But before this loading guide can be readily applied to fluctuating loads of the typical daily load cycle of distribution transformers, the loads must be converted into a simple rectangular load cycle. In Mr Beaver's paper a method is proposed whereby this can be done.

Howard M Edmunds described a polyphase adjustable-speed commutator-type motor. This motor has a stator winding similar to that of the simple squirrel-cage motor and an armature of standard dc construction. On the commutator are three brush studs for each pair of poles, set 120 electrical degrees apart. These brushes connect to the stator winding of a speed regulator, constructed like an induction-type voltage regulator, the rotor of which connects to the power supply with motor stator winding, Fig. 4. Adjusting the position of the regulator rotor adjusts motor speed over a range from 0 to above synchronous value. Reverse running can also be obtained.

This motor has full field at all speeds and is thus similar to the Ward-Leonard controlled dc motor and not to the field-weakened dc motor. For example, an ac commutator motor developing 10 hp at 600 rpm would be good for 30 hp at 1800 rpm, whereas a 10-hp, 600-rpm motor would still be good for only 10 hp when its field is weakened to give 1800 rpm. Applications of the motor have been made in a variety of industrial uses, of which the textile and printing industries have been prominent.

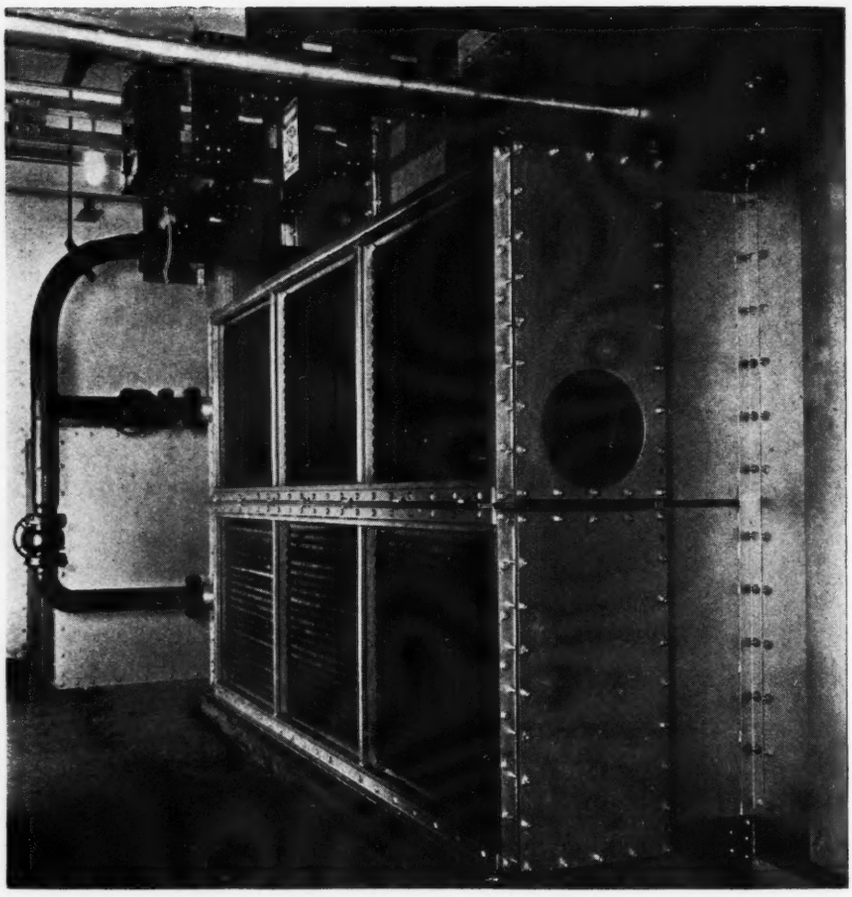


Fig. 2—Fin-type air cooler on a steel-mill motor cools ventilating air as it is recirculated

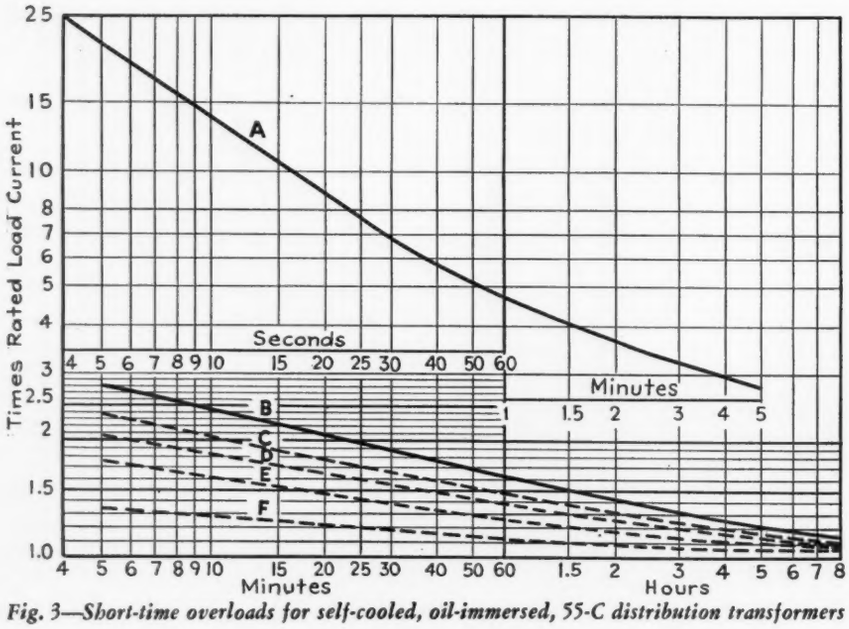


Fig. 3—Short-time overloads for self-cooled, oil-immersed, 55-C distribution transformers

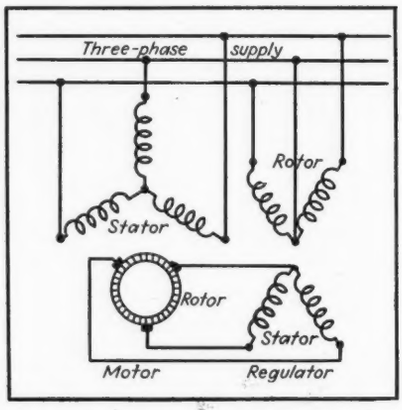


Fig. 4—Diagram of a commutator-type polyphase motor with voltage-regulator speed control

LOADING CONDITIONS ON WHICH THE CURVES, FIG. 3, ARE BASED

Curve	*Overload Condition*	*Initial Load*
A	Emergency	Full load
B	Recurrent	No load
C	Recurrent	50%
D	Recurrent	60%
E	Recurrent	75%
F	Recurrent	90%

USE THESE VALVES-
...lots of them!

THERE are many places where Edward forged body steel gage valves are useful. Although made to precision and quality standards, prices are astonishingly cheap. That's because they are so useful, in so many places, that the demand warrants quantity production with resultant low cost. Various fine steels are available for a variety of services. Walls are made heavy in proportion to internal passages to justify use on instrument lines at pressures up to 4,000 lb. Carefully cut taper threads of generous length make safe body-bonnet joints. The new knobbed handwheels give improved leverage and grip. For viscid fluids, at slightly lower pressures, there is the Fig. 150 companion line of straight through valves. Gage valve is Fig. 152. Try a few of each!

• • •

THE EDWARD VALVE & MFG. CO., INC.
EAST CHICAGO INDIANA

MADE IN SIZES ⅛" to 1"

EDWARD Valves
East Chicago, Indiana

STOP • CHECK • BLOW-OFF • NON-RETURN
FEED-LINE • RELIEF • BLEEDER LINE • ETC.

Power Lines

400,000 Kw New Turbine Capacity Ordered Since War Began

During the first six weeks of war, turbine manufacturers have listed well over 400,000 kw of new orders placed. Utility buying represents the lion's share; the unusual volume of orders results from the accelerating effect of the war on long-time programs, units being contracted for now that otherwise might not have been placed till later in the winter or spring.

Ten turbines go to central stations:

Safe Harbor Susquehanna River, Pa.	25,000 kw*
Manchester St Providence, R. I.	40,000 kw
Commerce St Milwaukee, Wis.	35,000 kw
Chester Philadelphia, Pa.	50,000 kw
Marion Jersey City, N. J.	50,000 kw
John C Weadock Bay City, Mich.	35,000 kw
Bucksport Bucksport, Me.	12,500 kw
Mobile, Ala.	35,000 kw
Macon, Ga.	35,000 kw
Kansas City, Mo.	35,000 kw
Ten turbines	352,500

**Hydro, single-phase generator.*

In addition, one 20,000-kw unit has been ordered for the City of Glendale, Calif., municipal plant. Industrial plants account for about 50,000 kw more as of present writing.

Engineers Honor Dr. Scott

"When there are greener fields to be cultivated by the engineering profession" said Dr Frank B Jewett, President of the Bell Telephone Laboratories, "Professor Scott will have at least one hand on the plow."

Over a hundred friends and associates of Dr Charles Felton Scott, pioneer engineer and educator, used the excuse of his 75th birthday, Sept. 19, to recall engineering Scott-connected developments. Among the speakers were Robert S Judd, chief engineer, Southern New England Telephone Co; Charles E Stephens, vice-president, Westinghouse Electric & Mfg Co; F Malcolm Farmer, president, Electrical Testing Laboratories and president of the American Institute of Electrical Engineers. Dr James Rowland Angell, president emeritus of Yale University and Ex-Governor Wilbur L Cross of Connecticut added personal reminiscences drawn from Dr Scott's 25 years as an educator.

Dr Scott, described by Mr Farmer as "outstandingly versatile both as an engineer and in the education and training of engineering students", started his career as assistant tester for the Westinghouse Co, soon working his way to Chief Engineer for that Company. Associated with every phase of the development of alternating-current generation and transmission during the rapid changes in the art at the turn of the century, Dr Scott's contributions to electrical engineering were recognized by his election in 1902 to the presidency of the American Institute of Electrical Engineers.

Leaving industry, he undertook what he has since considered his life work, the education and training of student engineers. He is now professor emeritus of Electrical Engineering at Yale University. Since his retirement from active teaching he has piloted the Connecticut State Board of Registration of Professional Engineers as well as holding the chairmanship of the Engineers Council for Professional Development and the presidency of the Society for the Promotion of Engineering Education. He is now president of the Association of State Licensing Boards.

Chemical Industries Show

Over 40 industries, producing chemical materials and equipment, will display their newest products at the 17th Exposition of Chemical Industries. The Exposition, for which nearly 300 exhibitors have already engaged space, will be held at Grand Central Palace, New York, N.Y., during the week of December 4 to 9, 1939.

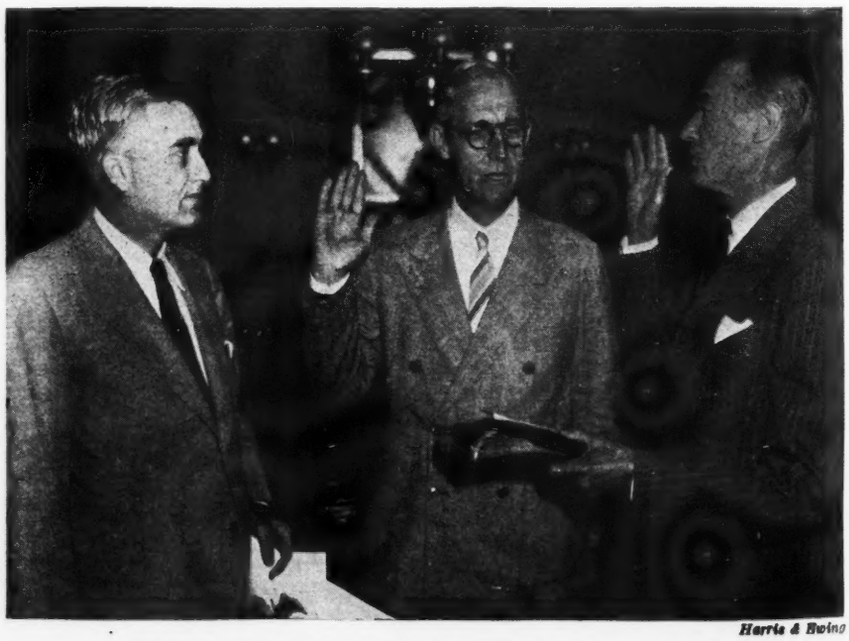
In addition to the chemical raw materials and manufactured products which the Chemical Industry will exhibit at the Exposition, there will be many displays devoted to metals and alloys; also to the new synthetic plastics and their versatile applications. Plant machinery and equipment applicable to each of the unit processes of chemical engineering, will also be shown.

The 17th Exposition, like all of its predecessors, will be under the direction of Charles F Roth, president of the International Exposition Co. Permanent headquarters are at Grand Central Palace, New York, N.Y.

Cooling-Tower Association

An association of water-cooling-tower manufacturers was recently formed, with headquarters at W J Parker Inc, 7 East 44th St, New York, N.Y. Members are: Binks Mfg Co, Foster Wheeler Corp, The Fluor Corp, Lilie-Hoffman Cooling Towers, Inc, The Marley Co, and Research Corp.

Officers elected at the first meeting were:



Harris & Ewing

NEW NAVY CHIEF OF ENGINEERING TAKES OATH

Rear Admiral S M Robinson (center) takes oath as chief of the Bureau of Navy Engineering, administered by Judge Advocate General of the Navy, Rear Admiral Walter B Woodson (right). At left is Acting Secretary of the Navy Charles Edison

LESS TIME OUT

for Boiler Cleaning and Repairs

READ THESE REPORTS

Boiler on line 13 months!

AN INDICATION of results being obtained with Nalco service for softening plants is contained in a report received recently covering a boiler inspection: "Boiler on line 13 months and 2 days and no scale nor corrosion."

18 Months Continuous Service!

HERE is a report on Nalco external treating: "Yesterday this No. 4 boiler was inspected for the first time after 18 months continuous operation and was found in such good condition that it was placed back on the line immediately."

2 Years Without Turbining Tubes!

A RECENT REPORT on a plant using Nalco stabilizing and internal treatment reads: "They have run two years without turbining their boilers. Their make-up is 100%. Their feedlines and heater are absolutely clean."

IF YOU are interested in reducing the amount of outage commonly experienced with your boilers, we suggest that you investigate the records of plants using the Nalco System of Feedwater Treatment. We will be glad to give you names of users near you. Write NATIONAL ALUMINATE CORPORATION, 6222 W. 66th Place, Chicago, Illinois.

ANY WATER **NALCO SYSTEM** ANY PRESSURE

Inquiries other than domestic, *except those from U. S. Possessions, Canada and Mexico,* should be addressed to ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, Eng. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

president, L T Mart of The Marley Co; vice-president, W J Hoffman of Lilie-Hoffman; and secretary-treasurer, W J Parker. The association has prepared a program of future accomplishments, included in which is a standardization code.

PERSONALS

CHARLES E WEBSTER has been appointed general manager of the Timken Roller Bearing Co, Ltd, with offices at 55 Charles St, West Toronto, Ont. Mr Webster was born in Canada, and has been associated with Timken Canadian activities for 20 years.

JOHN F COLLINS, JR, has entered the employ of the National District Heating Assn as secretary-treasurer. He was formerly with the Allegheny County Steam Heating Co. The headquarters of the N D H A has been established at 1231 Grant Bldg., Pittsburgh, Pa., and will be maintained at Mr Collins' office.

CHARLES MCDONOUGH, advertising manager of the Combustion Engineering Co, New York, was elected president of the National Industrial Advertisers Association

at the closing session of the annual conference held at the Hotel New Yorker, New York, last week. During the past three years as vice-president of the NIAA Mr McDonough supervised national as well as local publicity, and was in charge of the employment service started two years ago. One of his more important association activities during the past three years has been an extensive study of the public-relations problems of industry.

R CARSON DALZELL has been appointed technical advisor at the Baltimore Div, Revere Copper & Brass, Inc, offices at 1301 Wicomico St, Baltimore, Md. Mr Dalzell was graduated from Johns Hopkins University in 1927, and attended the Graduate Engineering School of Harvard University.

MAJOR ALBION N VAN VLECK announces resignation as First Deputy Commissioner of Housing and Buildings of the City of New York. He will resume practice of consulting engineering in association with firm of William Raisch & Assoc, New York, N.Y.

HARRY SLATTERY of Greenville, S.C., undersecretary of the interior, was recently

(*Continued on page 148*)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Calif., Ventura—City plans election Nov. 7, to vote $1,200,000 bonds to finance acquisition and construction of electric power plant and distribution system. C. Froerer, City Hall, engr.

Conn., East Hartford—Albert Kahn, Inc., archts., New Center Bldg., Detroit, Mich., taking bids (from selected list of bidders), constructing 1 story, 320x860 ft., brick, steel power plant and factory addition, for Pratt & Whitney Aircraft, Div. United Aircraft Corp., 400 Main St. Over $40,000.

Conn., West Haven (br. New Haven)—Armstrong Rubber Co., 475 Elm St., taking bids constructing 4 story, 100x150 ft., rein.-con. factory addition. $200,000. Fletcher-Thompson, Inc., 1336 Fairfield Ave., Bridgeport, engrs.

Fla., Fort Lauderdale—Florida Power & Light Co., Fort Lauderdale, plans constructing plant additions, installing 25,000 kw. oil burning steam generating plant. $3,000,000 appropriated. Private plans.

Fla., Pensacola—Florida Pulp & Paper Co., c/o J. C. Pace, pres., plans constructing plant structural steel frame, steel truss roof. $3,000,000.

Ga., Macon—Georgia Power Co., c/o P. S. Arkwright, pres., Electrical Bldg., Atlanta, plans constructing 60,000 hp. or 40,000 sustained kilowatts steam operated plant, 22 acre tract, Ocmulgee River, $4,000,000. Awarded contract for 35,000 kw. turbo generator, to Westinghouse Electric & Mfg. Co., 150 Bway., New York City. $750,000.

Ill., Carlyle—City soon takes bids improving light and power plant, turbo generator, smokestack and river intake. $130,000. Caldwell Eng. Co., Jacksonville, engrs.

Ill., Champaign—University of Illinois, Urbana, taking bids constructing Contr. V, W, X and Y for power building. Sargent & Lundy, Inc., 140 S. Dearborn St., Chicago, engrs.

Ind., Dresser—Public Service Corp. of Indiana, 800 Traction Bldg., Indianapolis, plans constructing 1 story, basement, brick, steel, rein.-con. power plant, 50,000 kw. steam generator unit. $4,000,000. Private plans.

Ind., Huntington—Bd. P. Wks., F. E. Cutshell, chn., City Hall, made surveys improving electric plant and waterworks, Diesel generating plant, electric driven turbine pumps, reconditioning present boilers and turbine, power lines, 500,000 gal. elevated steel tank, c.i. mains, water softener. $364,000. Lennox & Matthews, 833 Architects & Builders Bldg., Indianapolis, consult. engrs.

Ia., Estherville—Bids Oct. 30, by City, improving municipal electric light and power plant, 1 diesel engine over 1500 hp. and equip. Over $25,000.

Ia., Lowden—Town plans election Nov. 9 to vote on construction municipal electric light and power plant. $70,000.

Ky., Owensboro—City, c/o H. Smith, mayor, soon takes bids constructing light and power plant improvements, power plant wiring, changes in coal and ash handling system and distribution system, etc. Black & Veatch, 4706 Bway., Kansas City, Mo., engrs.

Md., Vienna—Eastern Shore Pub. Serv. Co. of Delaware, Salisbury, Md., and 57 William St., New York (incl. Delmarva Power Co., and Maryland Light & Power Co., owned by above), plans expansion and remodeling generating plant, installing 7,500 kw. turbine unit and laying base for second of similar capacity. $600,000.

Minn., Moorhead—City, R. G. Price, clk., Water & Light Bd., F. Wenzel, pres., plans election this fall to vote on authorization building changes, new 3,000 kw. generator, transformer room, switchboard, etc., at electric power plant. $200,000. Helmick, Edeskuty & Lutz, 412 Essex Bldg., Minneapolis, engrs.

Mo., St. Louis—Blanton Co., 318 S. 2 St., plans constructing rein.-con. factory for manufacture of oleomargarine, etc., on river front, between Angelrodt and Dock Sts., east of Burlington R.R. tracks. Approximately $400,000. Site purchased.

N. Y., East Rochester—Village Bd., plans bond election Dec. 8, to construct municipal diesel generating electric plant, Chestnut St. $350,000. L. C. Reynolds, c/o owner, engr.

N. Y., Gouverneur—U. S. Steel Corp., 71 Bway., New York, surveys made by Universal Exploration Co. (subsidiary), c/o owner, constructing zinc plant. Over $500,000.

O., Cleveland and Youngstown—Republic Steel Corp., Republic Bldg., Youngstown, plans constructing plant expansion and improvements. $3,000,000. Funds appropriated. Private plans.

O., Deer Park—J. R. Larbes, mayor, B. Kingery, chn. Light & Water Com. of Village Council, making surveys on construction costs, etc., for constructing municipal electric power plant. Burns & McDonnell Eng. Co., 307 E. 4 St., Cincinnati, engrs.

O., Warren—Copperweld Steel Co., Glassport, Pa., plans constructing new electric alloy steel and wire plant, 5 factory buildings, complete plant to have 6 acres under roof, capacity 100,000 tons alloy steel a year, with rolling capacity 250,000 tons year. $2,200,000. Private plans.

O., Warren—Ohio Public Service Co., Warren, plans extending power facilities to site of proposed new plant of Copperweld Steel Co. $1,500,000. Private plans.

O., Youngstown—Youngstown Sheet & Tube Co., Poland Ave., plans constructing new continuous gas butt weld tube mill at its nearby Campbell, O., plant, $200,000-$250,000.

Pa., Brookville—Jefferson Rural Electric Co-op. Assn., H. E. Porter, supt., Christy Bldg., Brookville, making plans constructing electric substation, at Conifer, near here. Gibbs & Hill, Penna Sta., New York, engrs.

Pa., DuBois—Bids about Nov. 1, by DuBois-Martin Aircraft Corp., c/o R. H. Martin, DuBois, 1 story, aircraft manufacturing plant. $250,000 with equip.

Pa., Glassport—Copperweld Steel Co., 9th St. and Allegheny Ave., sketches constructing electric steel plant. $2,000,000. S. Townsend, 9 St. and Allegheny Ave., engr.

Pa., Harrisburg—Pa. Power & Light Co., P. P. & L. Bldg., Allentown, will construct additions and alterations to Cedar St. power plant, here, doubling existing capacity installing 2 boilers, producing 185,000 lb. steam per hr., etc., by own forces. $3,000,000. Engineering Dpt., c/o owner, engrs.

Pa., Pitcairn—Boro, W. M. Hicks, secy. Boro Bldg., preliminary studies completed constructing 1 story, brick, steel, concrete light plant. Hunter & Caldwell, 3601 5 St., Altoona, engr. $200,000 bond election in November.

Pa., Somerset—Somerset Rural Electric Co-Op. Assn., Inc., and H. Jennings, supt., making plans constructing electric sub-station, Water Level Rd., near here. Gibbs & Hill, Penna Sta., New York, engrs.

S. C., Charleston—Wood Preserving Corp. of America, Koppers Bldg., Pittsburgh, Pa., rebuilding creosote treating plant, own forces. King St. exten., destroyed by explosion. $200,000. Private plans.

S. C., North Charleston—Rathborne Hair & Ridgeway Co., 1440 W. 21 Pl., Chicago, Ill., is negotiating with city of Charleston for 36 acre site for constructing paper carton factory. $500,000.

S. D., Lead—Homestake Mining Co., Lead, plans constructing saw mill, electric powered, log canal, hot pond, mill buildings, garage, shops, warehouse and office. Over $300,000.

S. D., Sturgis—Bids Oct. 25, by City, constructing electric power plant for sewage disposal plant. PWA. Chenoweth, Fraser & Forraine, Rapid City, engrs.

S. D., Wagner—City plans constructing plant and distribution system. $40,000. H. S. Nixon, Grain Exch. Bldg., Omaha, Neb., consult, engr.

Tex., Belton—Brazos River Conservation & Reclamation Dist., J. A. Norris, genl. mgr. Kyle Hotel, Temple, making plans constructing hydro-electric power dam and flood control project on Leon River at tributary of Brazos, near here, $2,400,000. J. A. Norris, Kyle Hotel, Temple, engr.

Tex., Corpus Christi—Central Power & Light Co. G. Gilliam, div. mgr., Corpus Christi, plans constructing power plant unit on Nueces Bay in vicinity of main Port Area, brick, steel, concrete steam turbo-generating station, installing 2 turbines and boilers, rein.-con. foundations. Total est. $1,000,000. Now taking bids earth excavating for foundation and basement and piling. J. T. Pearsons, ch. staff owners. Sargent & Lundy, 140 S. Dearborn St., Chicago, Ill., engrs.

Tex., Rutledge—Bids Oct. 25, by Lower Colorado River Auth., Llano and Austin, constructing rein.-con., brick, steel power house building for Marshall Ford Dam Hydro-Electric Project on Colorado River.

Wash., Tacoma—City, A. M. Angove, clk. Contract Bd., soon takes bids constructing lighting department, substation at Fort Lewis Army Base, near here. $67,000. C. D. Forsbeck, City Hall, engr.

Wash., Vancouver—Stebco, Inc., Vancouver, plans constructing lumber mill, planing mill, office, 400 ft. wooden dock, 26 acre site on Columbia River. $200,000. Maturity this fall.

Alta., Edmonton—Municipality plans by J. Maitland, City Hall, 1 story, basement, brick, steel substation, plain found., 103rd Ave.

N. B., Bathurst—Bathurst Power & Paper Co., Ltd., R. L. Weedon, genl. mgr., making plans and soon takes bids constructing plant extension. $500,000. Private plans.

Ontario—Hydro-Electric Power Comm. of Ontario, R. T. Jeffrey, engr., 620 University Ave., Toronto, plans constructing power development on Muskoko and Musguash Rivers in Georgian Bay Dist. $2,600,000.

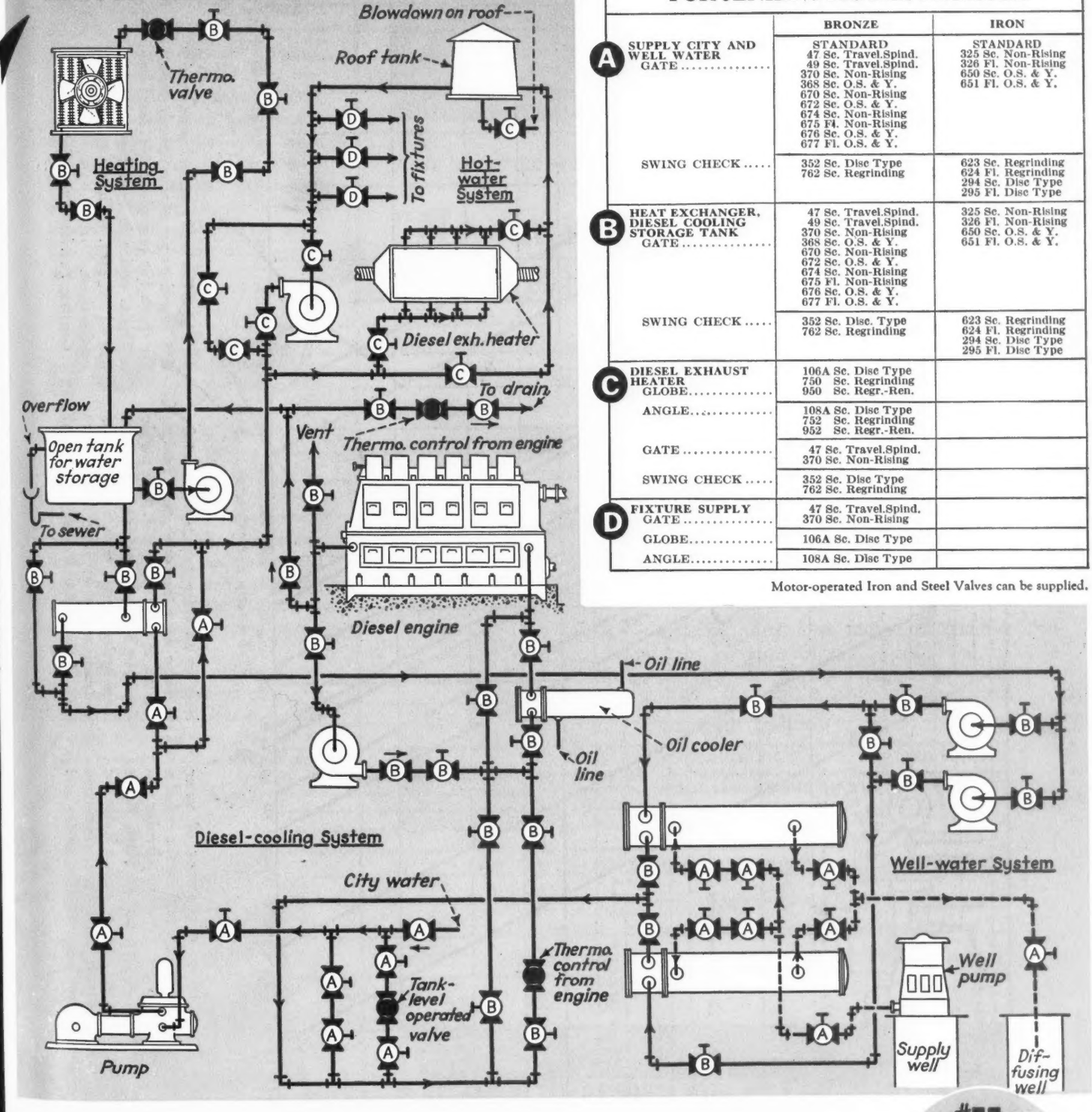
Ont., Niagara Falls—Hydro Comn., J. E. Techoe, supt., wants prices and information in proposed auxilliary Diesel engine driven power plant and reservoir at Chippewa filtration plant.

Ont., Red Rock—Lake Sulphite Pulp & Paper Co., Ltd., Red Rock, plans completing plant and possible conversion to munition manufacture. $1,000,000. Financing underway.

. . . TO *GOOD* VALVE PRACTICE

Jenkins RECOMMENDS . . .

HEAT RECOVERY



REFERENCE CHART FOR JENKINS FIGURE NUMBERS

		BRONZE	IRON
A	SUPPLY CITY AND WELL WATER GATE	STANDARD 47 Sc. Travel.Spind. 49 Sc. Travel.Spind. 370 Sc. Non-Rising 368 Sc. O.S. & Y. 670 Sc. Non-Rising 672 Sc. O.S. & Y. 674 Sc. Non-Rising 675 Fl. Non-Rising 676 Sc. O.S. & Y. 677 Fl. O.S. & Y.	STANDARD 325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S. & Y. 651 Fl. O.S. & Y.
	SWING CHECK	352 Sc. Disc Type 762 Sc. Regrinding	623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type
B	HEAT EXCHANGER, DIESEL COOLING STORAGE TANK GATE	47 Sc. Travel.Spind. 49 Sc. Travel.Spind. 370 Sc. Non-Rising 368 Sc. O.S. & Y. 670 Sc. Non-Rising 672 Sc. O.S. & Y. 674 Sc. Non-Rising 675 Fl. Non-Rising 676 Sc. O.S. & Y. 677 Fl. O.S. & Y.	325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S. & Y. 651 Fl. O.S. & Y.
	SWING CHECK	352 Sc. Disc. Type 762 Sc. Regrinding	623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type
C	DIESEL EXHAUST HEATER GLOBE	106A Sc. Disc Type 750 Sc. Regrinding 950 Sc. Regr.-Ren.	
	ANGLE	108A Sc. Disc Type 752 Sc. Regrinding 952 Sc. Regr.-Ren.	
	GATE	47 Sc. Travel.Spind. 370 Sc. Non-Rising	
	SWING CHECK	352 Sc. Disc Type 762 Sc. Regrinding	
D	FIXTURE SUPPLY GATE	47 Sc. Travel.Spind. 370 Sc. Non-Rising	
	GLOBE	106A Sc. Disc Type	
	ANGLE	108A Sc. Disc Type	

Motor-operated Iron and Steel Valves can be supplied.

JENKINS BROS., 80 WHITE STREET, NEW YORK, N. Y.

Bridgeport • Boston • Chicago • Philadelphia • Atlanta • Houston

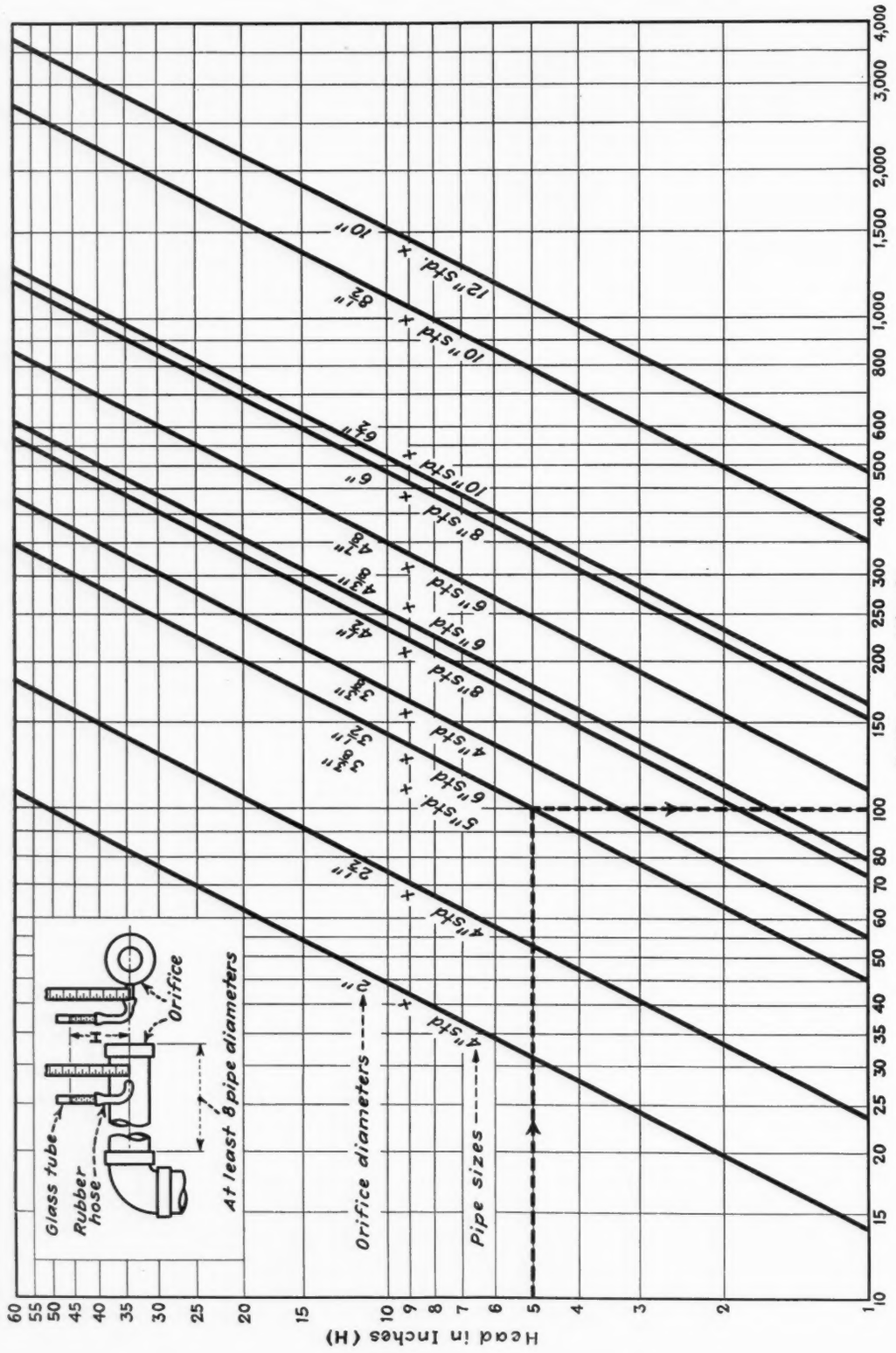
TRADE JENKINS MARK Jenkins Bros

1864—1939 DIAMOND ANNIVERSARY

#11 OF A SERIES designed to help in your selection of JENKINS VALVES

Number 88

Orifice-Discharge Chart



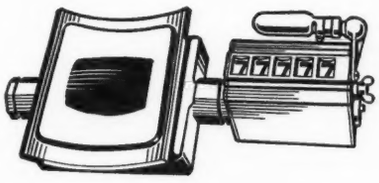
To MEASURE A QUANTITY of water flowing to atmosphere from the end of a pipe through a thin-plate circular orifice, drill a pipe cap or blank flange as shown or install an orifice inside the cap. Drill and tap a ⅛-in. connection about a foot back from the orifice and hook up an arrangement of glass tube to serve as a pressure gage reading directly in inches of water. Pipe nipple should be flush with inside of pipe. Pipe must be horizontal, with no elbows or obstructions for at least 8 diameters back of the orifice. For any of several sizes of orifice and standard pipe, read flow in gallons per minute directly from the chart. For example, a 5-in. head on a 3½-in. orifice in 6-in. pipe gives a flow of 100 gpm, see heavy broken line on the chart.

Courtesy Peerless Pump Company.

© POWER

The COPES Type A-D Coal Counter

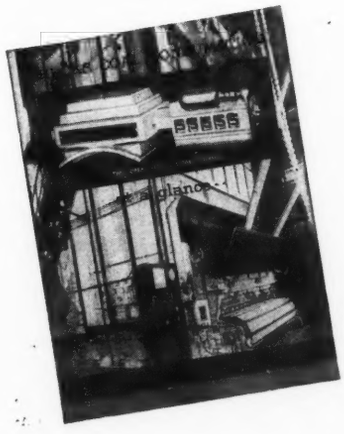
Helps build boiler efficiency. Gives an accurate, continuous reading of how much coal is fed to each stoker—indicating inefficient firing more quickly than any check of stoker revolutions or weigh larry reports. Inexpensive to buy, install and operate. Pays for itself quickly by making it easy to eliminate instantly operating inefficiencies. Saves time. The large illuminated dial is easily read at a distance of 30 feet.

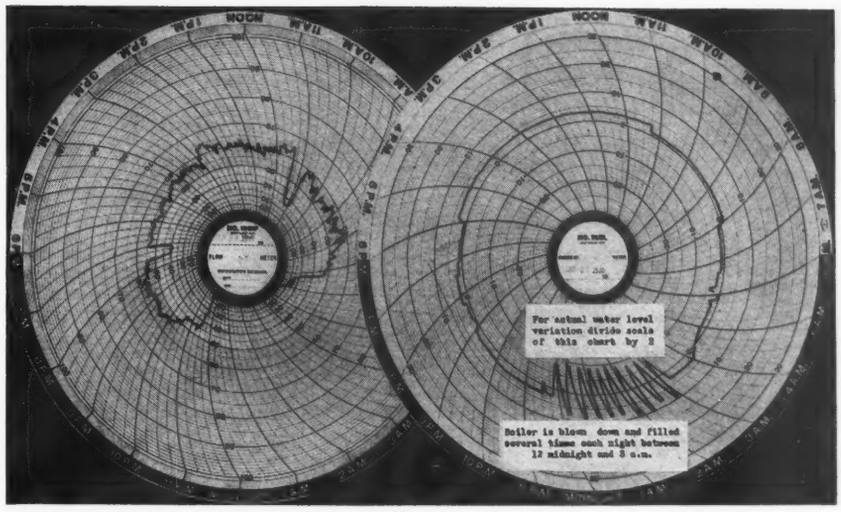


Only one part—a soft rubber roller, highly resistant to abrasion—comes in contact with the coal. Measurement continues accurate for a longer time than if it depended on any wearing metal part in, or in contact with, the abrasive material. Nothing to stick, or break off, and cause "bridging" of coal in the pipe.

The COPES Counter can also be used to measure the quantity of other such granular material as cement clinker, crushed rock, limestone, grain or ore being moved through an inclined pipe.

Write for Bulletin 411

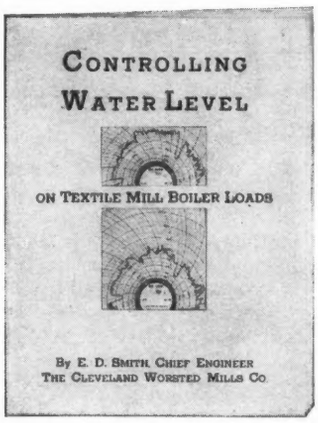



For actual water level variation divide scale of this chart by 2
Boiler is blown down and filled several times each night between 12 midnight and 3 a.m.

WELL SATISFIED WITH THIS FLOWMATIC PERFORMANCE BECAUSE

"No unit in our plant has operated with less attention"

Results at The Cleveland Worsted Mills Company emphasize two good reasons why the swing is to the COPES Flowmatic for effective feed water regulation in modern steam plants: Closer water level control on all loads—increasing safety, permitting higher efficiency. Trouble-free performance—this user says, "No unit in our plant has operated with less attention"—saving time in the boiler room, saving money in maintenance. For the story of results with COPES Flowmatic on Cleveland Worsted's new Vogt boiler, write for Bulletin 423. For savings with safety on your modern boilers, specify the simplified COPES Flowmatic Regulator.



NORTHERN EQUIPMENT CO., 1111 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

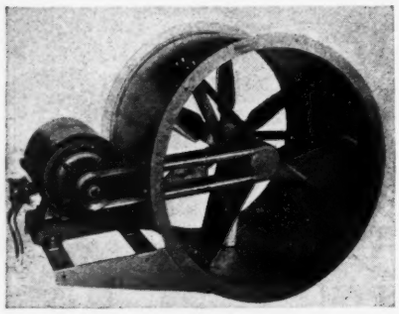
BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY AND ITALY
REPRESENTATIVES EVERYWHERE

★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR

What's New In Plant Equipment

Duct Fan

MADE for duct systems, fan operates against static pressures up to 3 in. Furnished in single- and tandem-fan types. Single-fan capacities range from 1600 to 26,000 cfm, while capacities of tandem units run from 1600 to 30,000 cfm. Blades

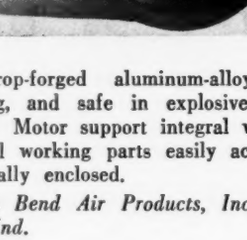


are drop-forged aluminum-alloy, nonsparking, and safe in explosive atmospheres. Motor support integral with fan unit, all working parts easily accessible, but totally enclosed.

South Bend Air Products, Inc, South Bend, Ind.

Flexible Coupling

"EQUALIZED" rubber-cushioned compressed drive is feature of 4R coupling. Differs from standard coupling in that it has seamless-steel ring moulded around outer extensions of rubber lugs, thus enclosing



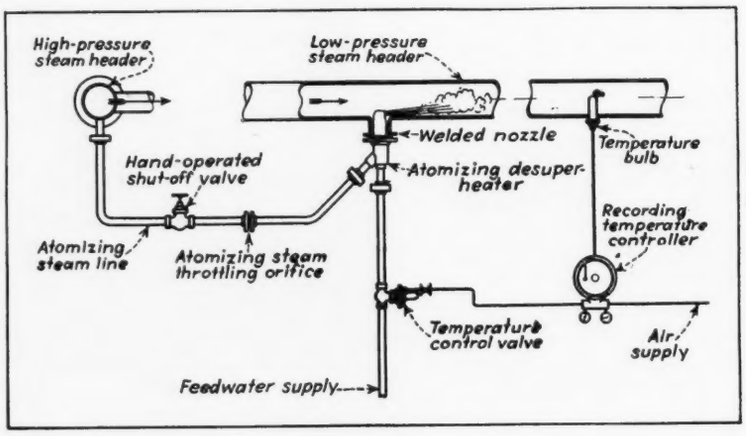
rubber into compression chamber. Oil-resistant rubber or Neoprene spider used between coupling halves has lugs concave curved, which mate with convex-curved surfaces in lugs on coupling halves, giving uniform compression on insert.

Certified Flexible Coupling Co, 122 East 42nd St, New York, N. Y.

Card Record System

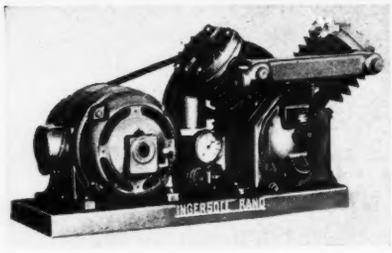
SUPER-VISIBLE system is housed in letter-type file cabinets having drawer fronts which swing forward, increasing visibility of each panel. Cards held on removable panels which are placed on file drawers similar to letter folders. Removal or card singly or in groups can be done through devices for handling.

Acme Visible Records, Inc, Chicago, Ill.



Compressor

TYPE 30 compressor ranges in size from ¾ to 15 hp. Utilizes "finger-valve" construction and is available with or without



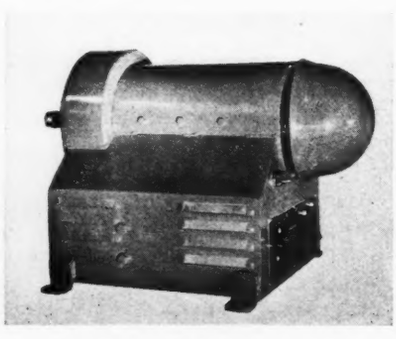
drive, receiver-mounted or bare. New line built in sizes up to 5 hp.

Ingersoll-Rand Co, 11 Broadway, New York, N. Y.

Arc-Welding Machine

"SHIELD-ARC JUNIOR" built for use in conjunction with engine or electric-motor drive. Rated at 200 amp and its current range, welding duty, 30-volt arc, is 60 to 250 amp. Equipped with dual continuous control, which permits independent adjustment of voltage and current. Generator is single operator, variable voltage type with laminated pole pieces. Generator armature is mounted on large shaft with pulley. Construction is arc welded steel, and welder is fitted with four steel feet drilled for bolting.

Lincoln Electric Co, 12818 Coit Rd, Cleveland, Ohio



Desuperheater

SMOOT steam-atomizing desuperheater has range of operation from zero to maximum flow, atomization by high velocity steam, and complete atomization at low as well as high flows because atomizing steam velocity is constant. Unit mounts in straight run of header on standard flange fitting, and can be installed in either horizontal or vertical header in any plane.

Republic Flow Meters Co, 2222 Diversey Parkway, Chicago, Ill.

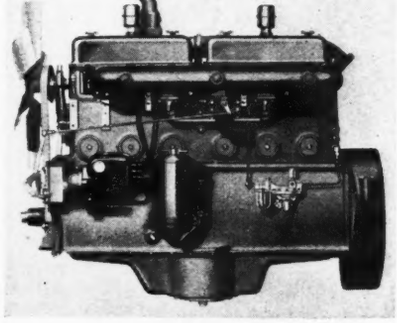
Welding Electrodes

PAGE "SURFACE-SAVING" electrodes are alloyed to meet demand for tough abrasion resisting materials. Said to be useful in welding surfaces and metal parts subject to excessive wear. Electrodes all inter-alloy with base metal when applied by metallic arc method, forming true welding bond.

Page Steel & Wire Div, American Chain & Cable Co, Inc, Monessen, Pa.

Poly-Cycle Engine

MULTI-FUEL type engine built to burn oil, gasoline, butane, producer or natural gas, convertible by changing fuel-burning acces-



sories. Engine is spark-ignition type, spark plugs being carried in cylinder head. Engine illustrated has 6 cylinders, with 3-in, 7-bearing crankshaft, and out-

CONTROL PRODUCTION · CUT OPERATING COSTS

BEAT

TIME·SPACE·POWER WASTE!

Learn How the Sensational New Allis-Chalmers Vari-Pitch Speed Changer Gives You More For Your Power Dollar...With Easy, Quick, Time-Saving Speed Changing... to the Exact Speed That Gives You the Greatest Profit-Making Production Efficiencies!

INSTANTANEOUS SPEED CHANGING AT THE OPERATOR'S will — that's the story behind the sensational success of the new Vari-Pitch Speed Changer! Note here the extremely compact mounting arrangement, using the new Allis-Chalmers Paraline base which automatically maintains correct tension on the drive . . . keeps motor on even level . . . adds to the drive's efficiency!

Ask Yourself These Questions — Would your machines produce more if they ran faster . . . or slower . . . or the speeds could be changed at the operator's will to suit changing conditions? Could you get a better finish . . . a more accurate product . . . less spoilage? Would your machines give you 5%, 10%, or even 20% more production if you had the advantages of smooth, instantaneous speed control?

The Answer is The Vari-Pitch Speed Changer! — This new, modern speed changer eliminates multi-speed motors and time-wasting change-overs . . . gives new simplicity to what in many plants is a complicated process . . . cuts operating costs! Compact in size . . . silent in operation . . . it requires only a simple turn of the hand wheel to give you the exact speed you want in ratios up to 3¾ to 1. Or it can be equipped with electrical remote control for extra-fast speed changing.

Get the Facts Now! Don't delay learning about this money-saving Speed Changer! Let this sensational new method save you money in your plant! Get in touch with the district office near you . . . or send for Bulletin 1266A. Learn the facts about the Allis-Chalmers Vari-Pitch Speed Changer that sets new record lows in operating costs . . . controls production . . . beats time, space, and power waste!

Available in sizes from 1 to 75 hp, ratios up to 3¾ to 1, maximum output speed 3500 rpm, the Vari-Pitch Speed Changer is a product of Allis-Chalmers, originators of the Texrope Drive and the Vari-Pitch Sheave.

1010

Vari-Pitch Speed Changers • Texrope V-Belts • Duro-Brace Texsteel Sheaves • Vari-Pitch Sheaves • Standard Cast Iron Sheaves • Adjustable Pitch Diameter Texsteel Sheaves • 2-3-4 Combination Sheaves • Straitline Automatic Motor Bases • Oil Field Drilling Rigs

Belts by Goodrich

TEXROPE DIVISION

ALLIS-CHALMERS

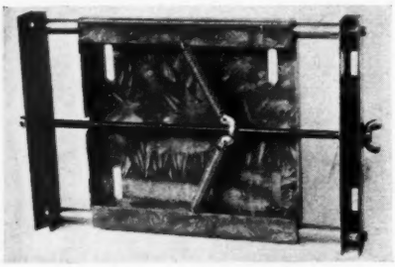
MILWAUKEE·WISCONSIN

put of 125 hp at 2100 rpm. When built as gasoline engine, elbow air horn at intake side is replaced with carburetor. Injection equipment on opposite side is omitted and plugs are inserted in place of fuel nozzles, being of same volume to maintain compression.

Waukesha Motor Co, Waukesha, Wis.

Motor Base

"IDEAL" base holds belt drive taut through spring tension. Covers any type drive, horizontal, vertical or overhead, and operates with any load, pulsating, steady, or reversing. To take up slack from normal wear and stretch, adjusting screws are



turned. Base moves back giving correct belt tension. Spring tension holds motor, takes up slack, and cushions load shock. To change belts, adjusting screws are loosened and new belt is placed around sheaves.

Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.

Undervoltage Relay

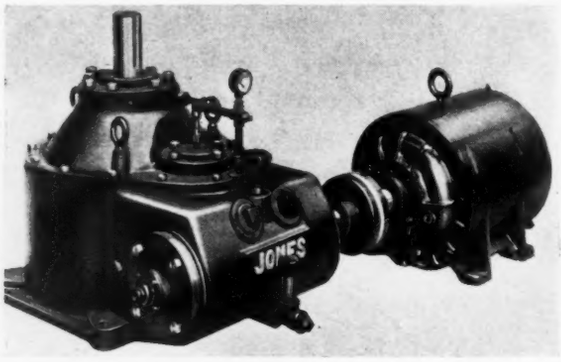
TYPE GGP combines high sensitivity and non-bouncing features of induction cup, polyphase, directional element with adjustable timing of induction-disk undervoltage element. Unit is designed to protect generators against motoring. Standard relay has sensitivity of ½ of 1% of full-load power.

General Electric Co, Schenectady, N. Y.

Speed Reducer

WORM-HELICAL speed reducers developed for vertical shaft drive where large reduction in speed is required. Available in 15 standard ratios from about 40 to 1 to approximately 250 to 1 for all common motor speeds and horsepower ratings.

W A Jones Foundry & Machine Co, 4401 Roosevelt Rd, Chicago, Ill.



Cleansing Compound

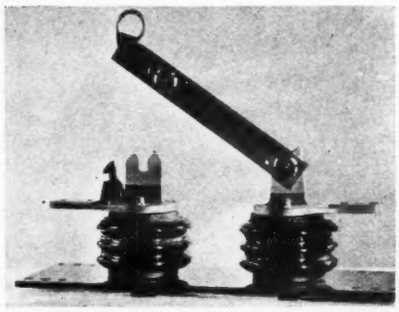
ANNITE Red Label detergent is low-titre vegetable compound made in powder form, and contains no caustic, lye, acid, abrasive, animal fats, or inert filler. Said not to have any injurious effect on personnel using it, and claimed to be non-inflammable. Packed in 5, 25, 50, 100, and 250-lb containers, can be used for hands, dishes, floors, etc.

Quigley Co, Inc, 56 W 45th St, New York, N. Y.

Indoor Disconnecting Switches

DESIGNED for hookstick or group operation, switches are available in sizes from 400 to 6000 amp for 7500- to 34,500-volt service. To increase ease of operation of switch, operating eye and blade latch have been designed to produce cam or pry-out action, which disengages blades from tongue member. Adjustable safety-blade stop halts blade at any one of three positions, or enables operator to lock blade in open position, guarding against accidental reclosing.

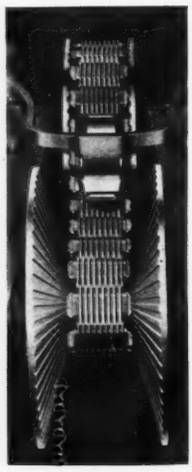
Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.



Variable-Speed Transmission

P I V variable speed transmission units comes in two new sizes, No. 0, ½-hp, for speed ratios of 2 or 3 to 1; and size No. ½, 1½-hp for ratios of 2, 3, or 4 to 1. Can be furnished for horizontal mounting, motorized or without integral motor, and with or without extra speed reduction sets.

Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.



Unit Heater

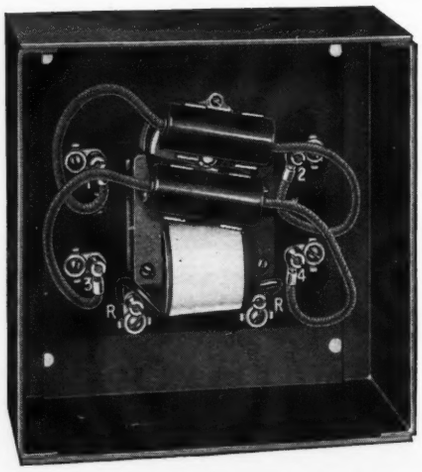
PROJECTION unit heater now available with anemostat, originally designed for duct applications. Vertical air stream projected straight down from heaters ideal

for anemostat distribution, enabling people to sit directly under unit, even on low-ceilinged installations.

Trane Co, La Crosse, Wis.

Rotating Relay

M-39 RELAY is only rotating type relay employing tilting mercury switch, designed for high-speed operation. Magnetic brake dampens movement of switch, making it "dead beat" in action. Mercury switch, attached to rotating disk on armature shaft of magnetic element, is unbreakable. Consists of iron tube, insulated cap and



refractory breaker. Breaker shields metal parts from the arc and retains pool of mercury in cap end of switch, making positive mercury-to-mercury contact. At 115 volts, ac, each switch has breaking capacity of 15-amp.

The Autocall Co, 28 Mack Ave, Shelby, Ohio

Resurfacer

POR-LOX system is made up of Por-Lox waterproofing, for actually waterproofing surface to which paint is applied, and preventing moisture contacting paint coating; and Por-Lox colored, weatherproof and sun-resistant coating in colors for application over waterproofing material. De-

SIXTEEN

NATIONALLY KNOWN COMPANIES PLACED REPEAT ORDERS FOR KEELER TYPE "CP" BOILERS

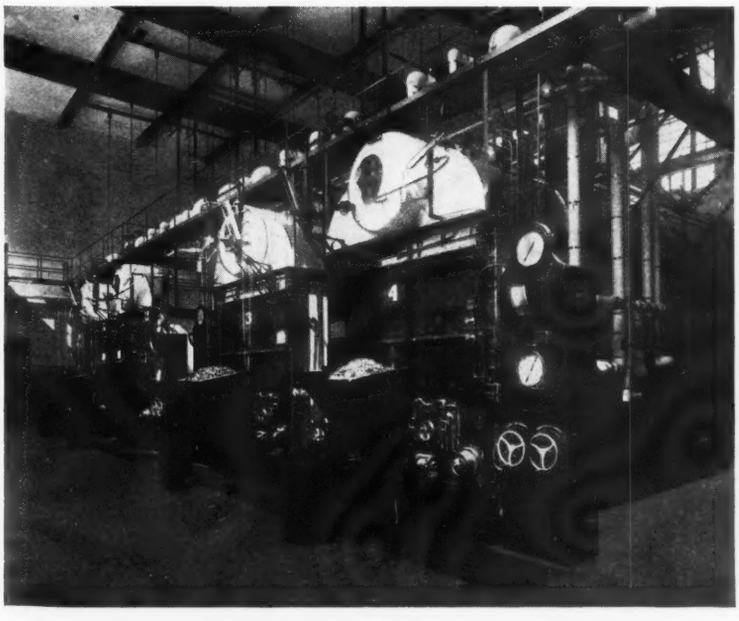
FOUR OF THESE SIXTEEN

COMPANIES HAVE PURCHASED

SIX OR MORE BOILERS

WHY?

FOR THE ANSWER RETURN THE COUPON



FOUR 200 HP UNITS
BOTANICAL GARDENS, MONTREAL, CANADA
Manufactured and Installed by
CANADIAN VICKERS LTD., MONTREAL, CANADIAN LICENSEE

350 INSTALLATIONS
IN 4½ YEARS

CAPACITIES UP TO 50,000 LBS
PRESSURES UP TO 450 LBS

E. KEELER COMPANY

WILLIAMSPORT, PA. USA

BUILDERS OF BETTER BOILERS SINCE 1864

Name .....
Position .....
Company .....
Address .....
City ..... State .....

signed for concrete tile, waterproofing soaks into concrete and bars all moisture from entering pores and crevices, while color coat bonds securely to waterproofing.

Truscon Laboratories, Detroit, Mich.

Air Filter—Silencer

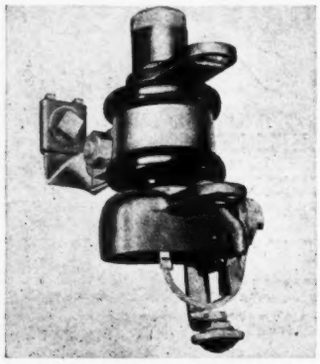
FOR APPLICATIONS where it is necessary to remove intake noises, but retain filtering qualities. Unit is available in two types, oil-bath and Unimaze. Silencing unit may

be detached from one model, and is built integral in another. Both models have capacity from 0 to 4000 cfm.

Air Maze Corp, 5200 Harvard Ave, Cleveland, Ohio

Low-Voltage Cutout

RATED at 250 volts, 100 amp, with interrupting capacity of 5000 rms amps, unit is for use on low-voltage distribution systems to prevent needless transformer failures, to isolate faulty sections in interconnected system of secondaries, to protect against overfusing and to provide



convenient means for disconnecting service. Cutouts can be fused with standard primary distribution fuse links having button heads, or with links made for secondary service carrying a button head. Blown fuses easily detected by indicator arm with red reflector.

Schweitzer & Conrad, Inc, 4435 Ravenswood Ave, Chicago, Ill.

Air-Cooled Transformer

STREAMLINED models cover all standard voltage characteristics from ¾ to 10 kva, in auto and insulated types. Manufacturer claims high full-load operating efficiency is maintained through following fea-

tures: air draft external ventilation, and wound hand-finished coils, with cores of low-loss steel. Unit adaptable for industrial application where use of oil-cooled transformers would affect fire-risk.

Acme Electric & Mfg Co, Cleveland.

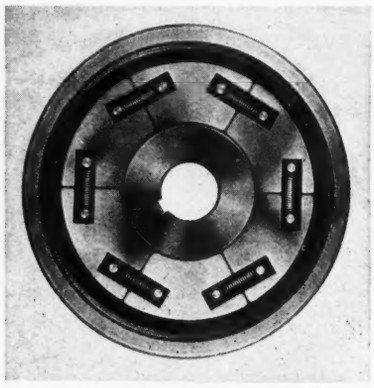
Neoprene Transmission Belt

BUILT to withstand destructive action of mineral oils on rubber friction compounds, Duroil Hewprene belt contains no natural rubber, being constructed of Neoprene synthetic materials. Friction and skim coat protect cotton duck against wear, ply separation, and softening from oil at high temperatures.

Hewitt Rubber Corp, Buffalo, N. Y.

Centrifugal Clutch

D-E AUTOMATIC centrifugal clutch consists of two main parts: housing drum, and expansion body. Steel cover-plate, held in position by lock ring, seals clutch mechanism against dust, etc. Expansion body consists of 6 metal segments inter-



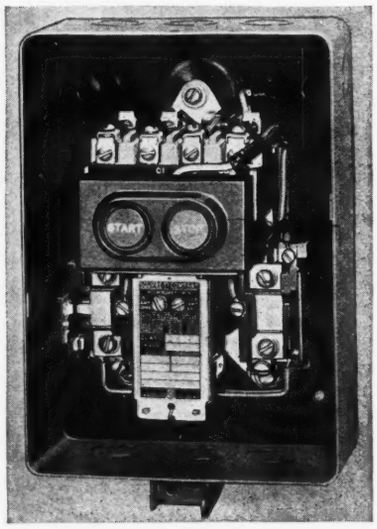
connected by tension springs and operating on individual posts extending radially from driving hub. When at rest, clutch is disengaged and can be built to engage smoothly at any desired speed or any horsepower.

Dawes Equipment, Inc, 2280 Penobscot Bldg, Detroit, Mich.

Motor Starter

TYPE R, class 8536 starter has maximum polyphase ratings of 2 hp, 220, 440, 550 volts; maximum single phase ratings are 1 hp, 110 volts or 1½ hp, 220 volts. Has vertically operating magnet, double-break silver contacts and thermal over-load relays. Available with general purpose, dust-tight, water-tight, or Class II, Group G enclosures; also as combination starter with either disconnect switch or circuit breaker.

Square D Co, Milwaukee, Wis.



Pointer-Stop Ammeter

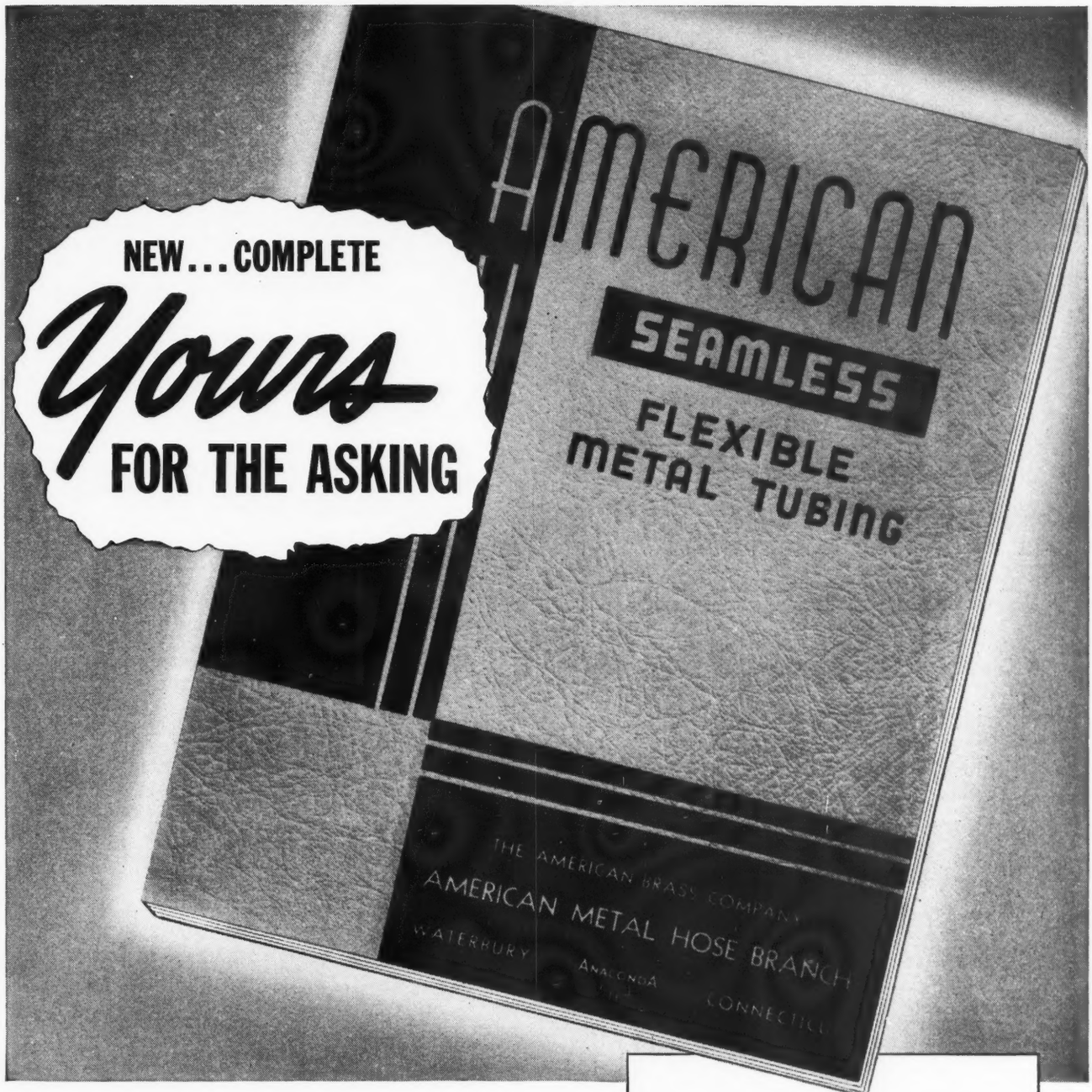
TYPE AP-9 are indicating instruments equipped with adjustable stop, micrometer-screw-actuated, arranged to push pointer up-scale. For measuring voltage-dip on voltmeters, stop is designed to push pointer down-scale. Measurements are made by successfully setting adjustable stop until position is reached where pointer barely moves in response to current or voltage impulse. Instrument then indicates rms current or voltage.

General Electric Co, Schenectady, N. Y.

Corrosion-Resistant Coatings

"IN-HIB-CO", new line of organic corrosion inhibitors, introduces chrom glucosate compounds for corrosion control into new fields. Prepared in several forms, and

(*Continued on page 136*)



IT'S THE NEW American *Seamless* Flexible Metal Tubing catalog. There are 24 pages and over seventy-five illustrations in this latest manual which we believe is the most comprehensive analysis ever published on the subject of seamless flexible metal tubing.

When requesting your copy, ask for Bulletin SS-P-25.

Partial list of Contents

Method of fabrication
Conveying of steam—of liquids—of gases; controlling vibration
Design of machinery
Specifications
Engineering data
Simple installation rules

39242

American Metal Hose

ANACONDA from mine to consumer

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn. • Subsidiary of Anaconda Copper Mining Company
In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

Experience . . .

"LISTEN KID," says Chief Joe, from under the new storage tank, "Cut me a 1x1 in. wedge 6 in. long. Know how?"

"Sure," says the youngster, pretty sure of himself. He saws a piece 1x1x6 and starts to chop with a shingling hatchet. About the third lick, he takes off the side of his thumb.

"Wrap it up," says Joe wearily, crawling out from under, "And watch!" So he takes a 1x1-in. stick about a foot long, chops the wedge on one end, then saws it to length.

Experience is still the best teacher—and association with experience the next best. Chances are good that Joe's helper will never make the same mistake again—or even one remotely like it. But, as Mark Twain said once: "We should be careful to get out of an experience only the wisdom that is in it—and stop there; lest we be like the cat that sits down on a hot stove-lid. She will never sit down on a hot stove-lid again—and that is well; but also she will never sit down on a cold one any more."

Many of our problems stem from the fact that we go out of our way to *avoid* experience, so that we can't evaluate it when we get it. We're a lot like the average auto driver, who may stare at a dashboard for twenty years and not know what the ammeter, oil gage, and water-temperature indicator are for. He drives by speedometer alone—and damns the car when it won't start or a piston seizes. He fights shy of the little understanding which would save endless trouble and expense. Yet all of us must pay for experience—whether it's our own or somebody else's.

Remember the old yarn of the chief who had a slap in the steam chest of his engine? After trying to fix it for weeks, he called in an expert. The expert listened a minute, then said, "Got a 2-lb hammer?" He walked up to the steam chest, gave it a smart sock, and the slapping stopped.

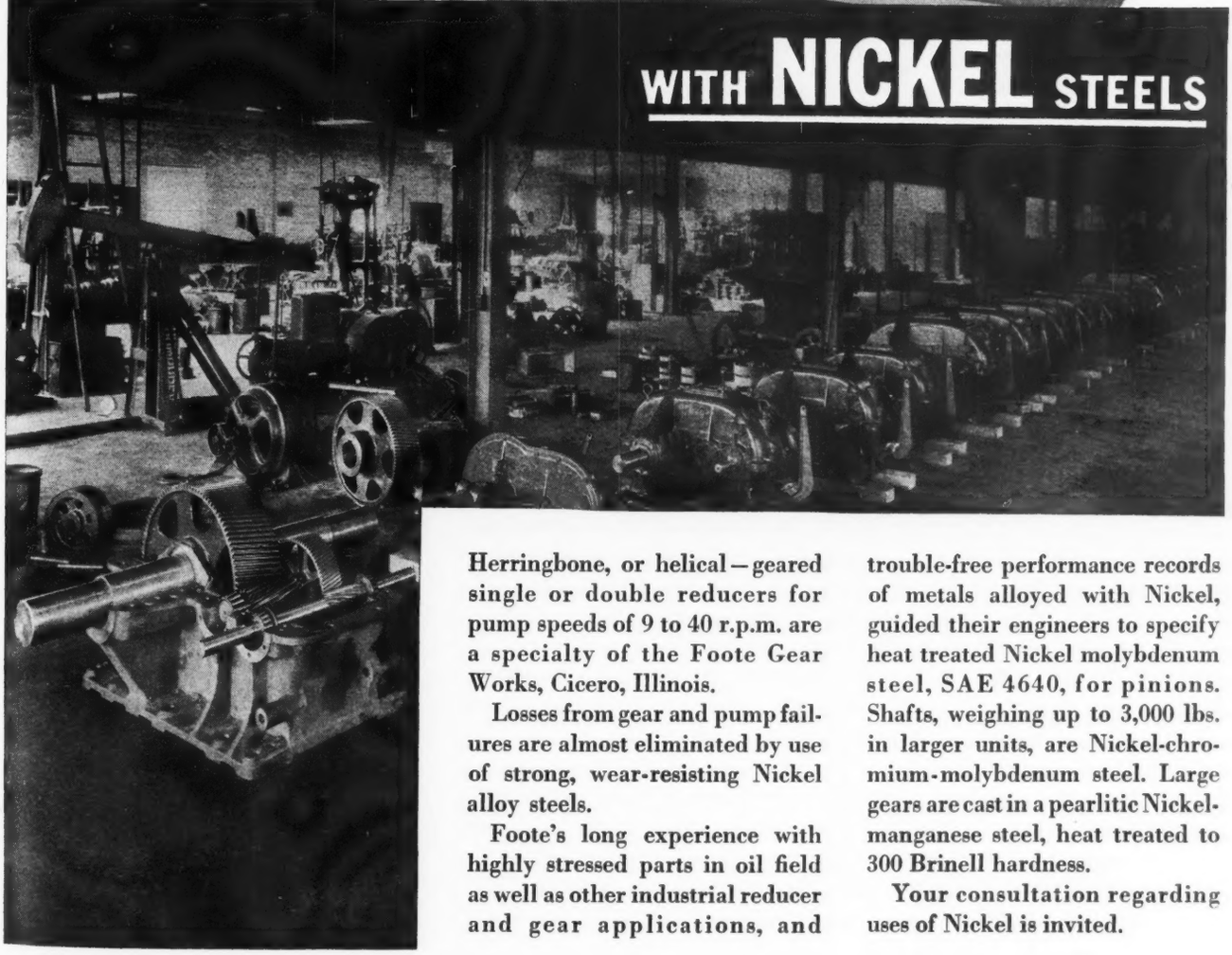
In due course, his bill came in. It was for $150. The chief blew up higher than a kite, then calmed down and asked for an itemized bill. Here's what it said:

For hitting steam engine with a hammer	$1
For knowing where to hit	$149
Total	$150

George Edwards

Engineer

WITH NICKEL STEELS



Herringbone, or helical—geared single or double reducers for pump speeds of 9 to 40 r.p.m. are a specialty of the Foote Gear Works, Cicero, Illinois.

Losses from gear and pump failures are almost eliminated by use of strong, wear-resisting Nickel alloy steels.

Foote's long experience with highly stressed parts in oil field as well as other industrial reducer and gear applications, and trouble-free performance records of metals alloyed with Nickel, guided their engineers to specify heat treated Nickel molybdenum steel, SAE 4640, for pinions. Shafts, weighing up to 3,000 lbs. in larger units, are Nickel-chromium-molybdenum steel. Large gears are cast in a pearlitic Nickel-manganese steel, heat treated to 300 Brinell hardness.

Your consultation regarding uses of Nickel is invited.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

WITH accurate, dependable Masoneilan Indicating Thermometers. These sturdy instruments eliminate peering into dark corners and climbing up or down ladders to read essential information. They bring temperature indications into well lighted areas as far as 300 feet from point of measurement; their large numerals and graduations enable operators to read them at a distance. Masoneilan No. 3000 Indicating Thermometers are furnished with Vapor Pressure or Gas Filled Thermal Systems. A variety of ranges from which to choose.

FOR FURTHER INFORMATION SEE OUR CATALOG IN SWEET'S

Like all Masoneilan Thermometers these instruments have thermal systems welded or brazed into a strong permanently sealed unit. Their accuracy and speed of response are unexcelled. Their low cost and long trouble-free service make them a true economy.

See page 33 of our Catalog in Sweets (Sec. 10/10) *or write for Catalog No. 39.*

MASON-NEILAN REGULATOR CO. MASONEILAN

New York Buffalo Philadelphia Pittsburgh
Tulsa Toledo Chicago St. Louis
Houston Los Angeles
Mason Regulator Co. of Canada, Ltd., Montreal

1186 ADAMS STREET
BOSTON, MASS., U.S.A.

New Equipment

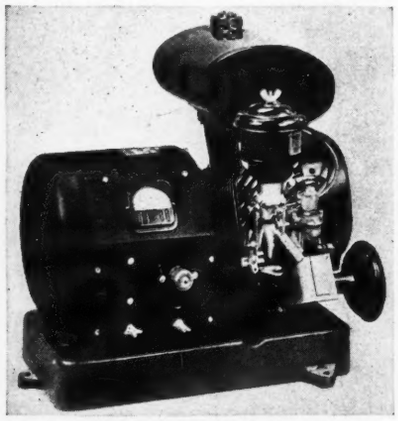
(*Continued from page 132*)

can be applied by spreading, spraying or brushing on exposed surfaces. Available in 50, 115, 250, and 400-lb drums.

D W Haering & Co, Inc, 2308 S Winchester Ave, Chicago, Ill.

Small Electric Plants

AC UNITS rated at 450 watts, dc at 500 watts, first named providing 110-v, 60-cycle current at 1800 rpm with reserve for temporary overloads. Electric push-



button starter built in, with 6-volt starter battery which can be automatically charged. AC types also available with remote-control stopping and starting stations.

Eicor, Inc, 515 S Laflin St, Chicago, Ill.

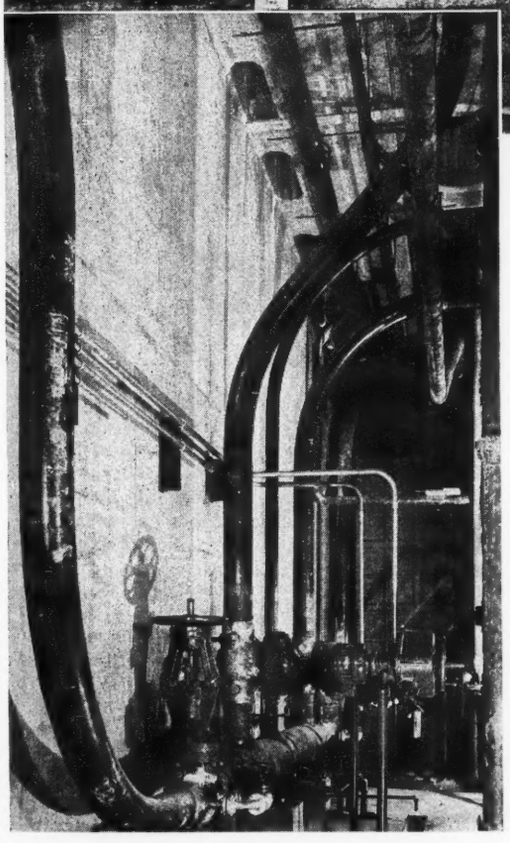
Water Analyser

NALCO PHOTOTESTER operates on principle that current which flows in circuit containing a photoelectric cell is propor-

tional to the illumination which the cell receives. Any method of analysis which allows either chemical precipitation or the development of a depth of color in proportion to presence of constituent being determined, can be adapted to tester. Unit designed as portable instrument and its current is supplied by single dry cell. When portability is not required, instru-

Another Great Power Plant - - - -
More "Valves by Chapman"

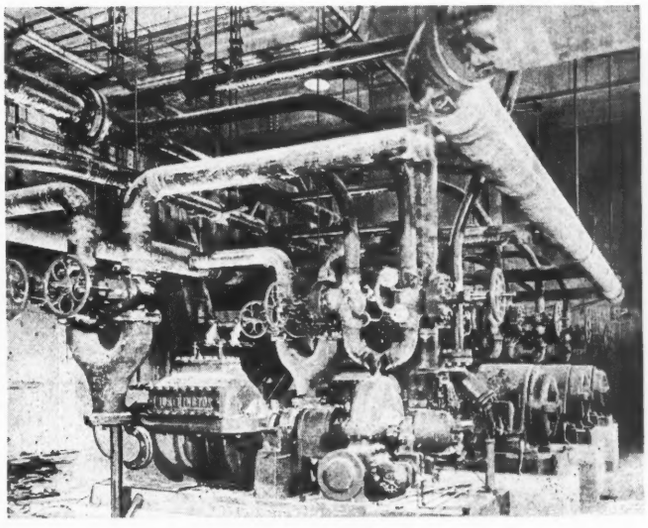
Chicago Sanitary District
New S. W. Power Plant, Stickney, Ill.



600 lbs. High Pressure Distribution Manifold. Chapman Steel Valves with welded ends. Note the Chapman Motor Unit.

A great many Chapman Valves, including over 200 Motor Units, are installed in the several plants of the Sanitary District of Chicago. The new S. W. Treatment Works at Stickney, Ill., has made extensive use of Chapman Valves for various services, notably the high pressure lines as indicated in the attached views, taken before the lines were covered and showing the extensive use of welding. Some 25 Chapman Motor Units were installed in this plant alone, indicating satisfactory service rendered by the many Chapman units previously installed in Sanitary District plants.

William A. Trinkhaus, Chief Engineer
William A. Dundas, Mechanical Engineer
Sanitary District of Chicago



(At Right)

600 lbs. Steam Turbine Boiler Feed Pump Connections. Note the 600 lbs. Chapman Steel Valves, welded ends, and 175 lbs. Iron Valves, flanged ends.

THE CHAPMAN VALVE
MANUFACTURING COMPANY
INDIAN ORCHARD, MASS.

NOW you can keep your High Pressure Valves Tight

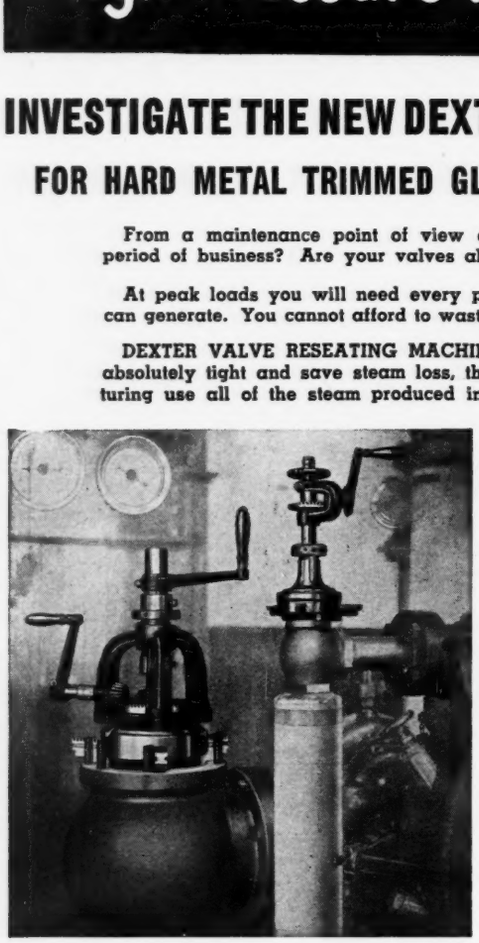
INVESTIGATE THE NEW DEXTER LAPPING DEVICE

FOR HARD METAL TRIMMED GLOBE and GATE VALVES

From a maintenance point of view are you ready for a boom period of business? Are your valves all tight?

At peak loads you will need every pound of steam your boilers can generate. You cannot afford to waste any of it through leakage.

DEXTER VALVE RESEATING MACHINES will make your valves absolutely tight and save steam loss, thus giving you for manufacturing use all of the steam produced in your power plant.



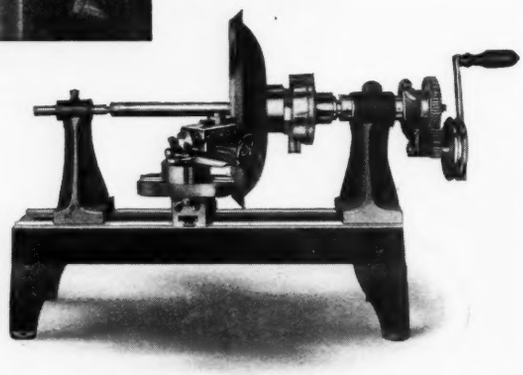
When a boom in business increases the purchasing of valves for replacements are you going to be able to get the sizes, types, etc. you need?

DEXTER VALVE RESEATING MACHINES will eliminate all this worry and trouble.

With these outfits you can repair the leaking valves you have without removing them from the line. You can also take the valves that you have consigned to the junk pile and make them absolutely drip-tight and use them as you would new valves.

All this can be done with a comparatively small investment that will pay for itself year after year.

Can you afford to overlook this sort of a proposition?



Let us give you more information on this very important matter of saving time and money in your maintenance department.

(Also manufacturers of the Swendeman Separators which keeps your compressed air lines oil- and water-free. Ask for new catalogue . . . just off the press)

THE LEAVITT MACHINE CO.

10 EAST RIVER ST. ORANGE, MASS.

Canadian Distributors:—

The Canadian Fairbanks-Morse Company Limited

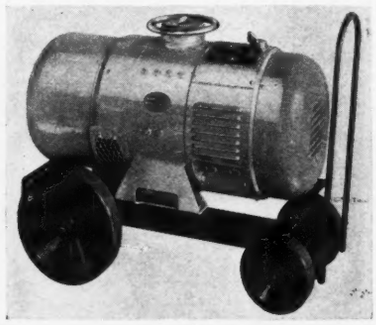
15 Branches Throughout Canada

ment may be connected to 6-volt storage battery or 6-volt bell-ringing transformer using ac current.

National Aluminate Corp, 6216 West 66th Place, Chicago, Ill.

Arc Welder

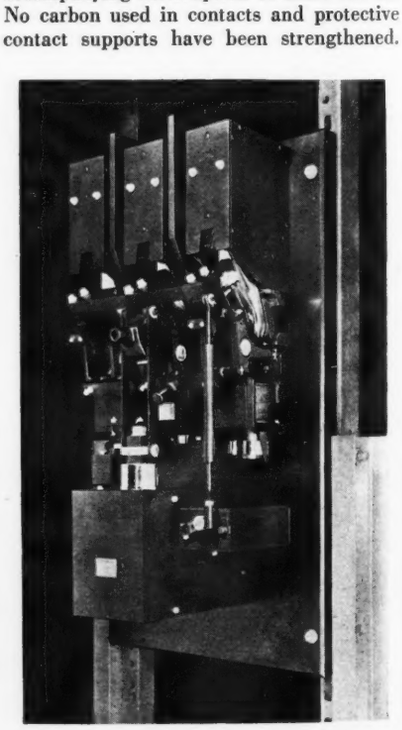
"HORNET" welder is controlled by handwheel located on top of unit. Adjustments of this wheel enable operator to obtain infinite number of current settings. Unit is 2-bearing, with motor rotor and generator armature mounted on common shaft. Ventilation provided by propeller blades attached to revolving shaft. Shielded arc electrodes are recommended, although unit will operate with same efficiency if bare electrodes are used.

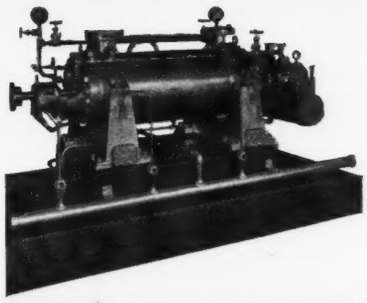


Wilson Welder & Metals Co, Inc, 60 East 42nd St, New York, N. Y.

Air Circuit Breaker

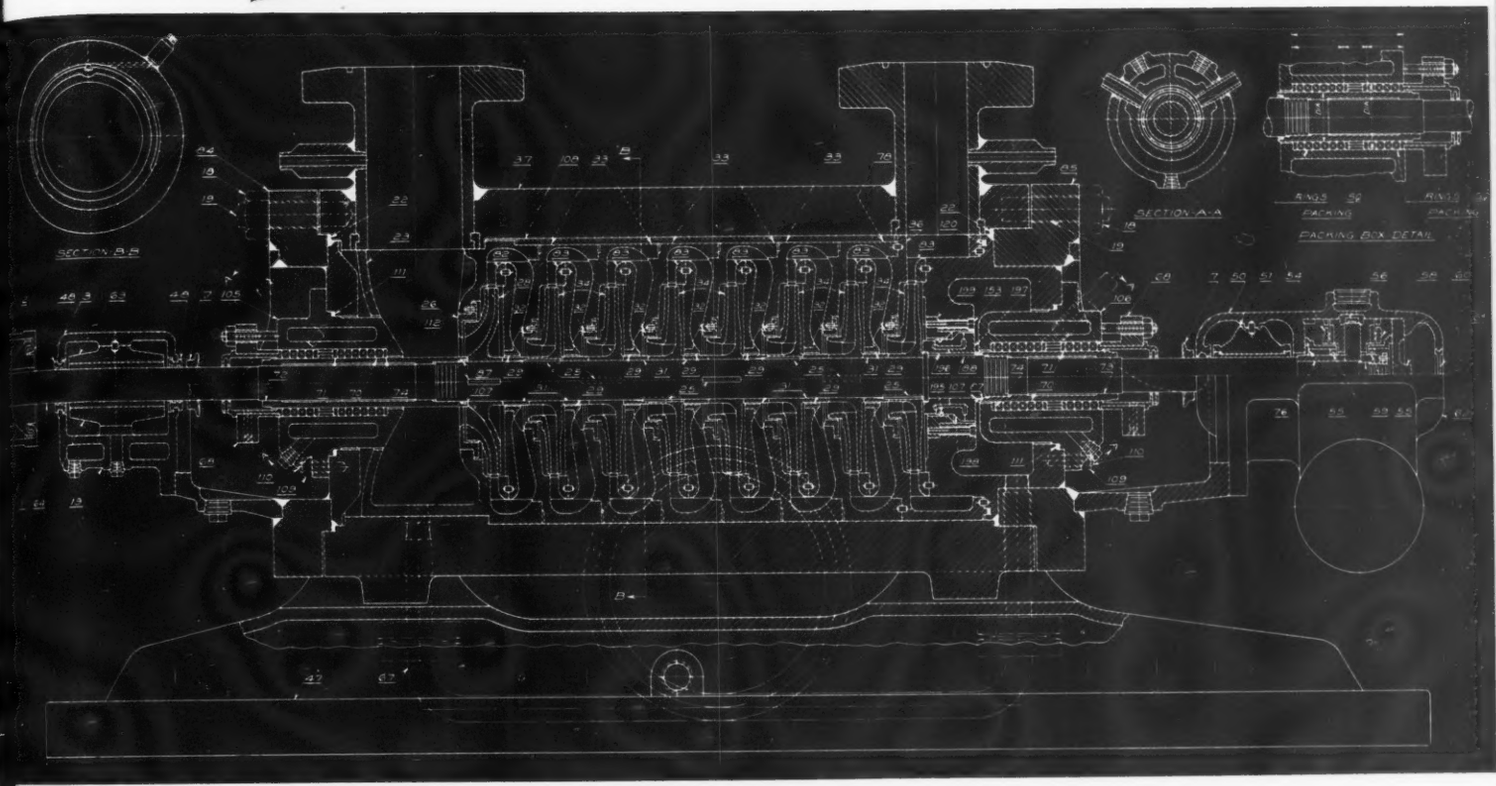
ABOUT ½ usual size for air circuit breakers, new unit has De-ion arc chamber, device which operates on either ac or dc current within the range of interrupting ratings; arcing current is limited to ½ cycle, which minimizes noise and flash accompanying interruption of short circuit. No carbon used in contacts and protective contact supports have been strengthened.





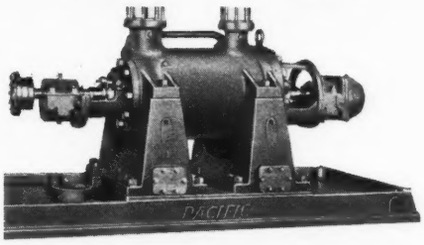
"PACIFIC", 4" S., 11-Stage, Type I.M.B.,—showing Lube Oil and Water-Cooling Piping, —Structural Steel Extended Base.

Experience

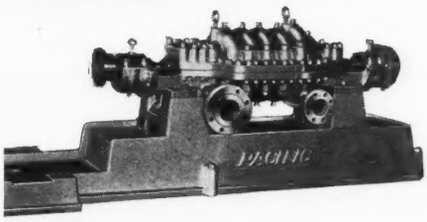


Protected under following United States Patents:

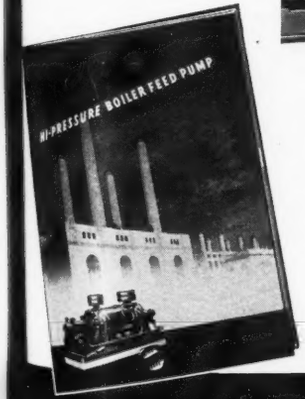
1,986,132	2,007,414	2,108,786
1,990,519	2,087,313	2,161,695



2", Type A.M.B., Multi-Stage, Solid Shell, Boiler Feed Pump,—with Cast Steel Case and Centerline Support,—Ball Bearing Mounted.



Type J.H.M.B., Horizontaly Split Shell, Multi-Stage Pump for high temperature conditions with Packing Boxes and Outboard Bearings arranged for water-cooling.



"PACIFIC" BOILER FEED PUMP DESIGN OUTSTANDING

Study the assembly drawing of a completely Forged-Steel, Double Case, "PACIFIC", Boiler Feed Pump. Here is a design evolved through long experience in building hundreds of pumps to meet difficult high-pressure, high-temperature pumping conditions. Note the engineering and construction features which give "PACIFIC" exclusive claim to distinct advances in Centrifugal Pump development. Illustrated Bulletin No. 74 describes the reasons for the various features of design developed through the years to meet the conditions encountered in this class of work.

Send for your copy of this new bulletin describing in detail the various types of Pacific Boiler Feed Pumps.

PACIFIC PUMP WORKS

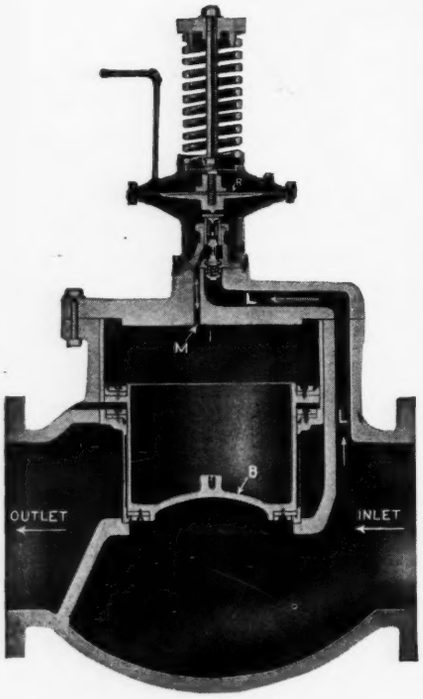
5715 BICKET STREET
HUNTINGTON PARK, CALIF.

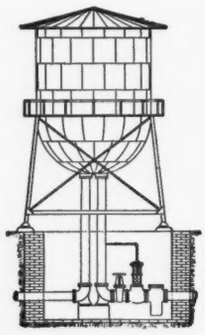
550 HARDING DRIVE
SO. ORANGE, NEW JERSEY

PACIFIC PUMPS

PIONEER THE WAY

Golden Anderson SPECIALTY VALVES





ALTITUDE CONTROL

● To keep efficiency at an even level, equip your tank or standpipe with G-A Altitude Control Valves. No overflow, but a constant, automatic water level at all times. In sizes of 2" to 36" (angle or globe patterns), this valve is positive in action, with no water or hammer shock. Air and water cushioned, it has full bronze trim with no metal contacts. Complete details of the entire G-A line can be had free. Write today for illustrated catalog.

also

Emergency Throttle . . . Float Control . . . Pressure Reducing . . . Triple Acting Non-return . . . Check Valves . . . Etc.

GOLDEN-ANDERSON VALVE SPECIALTY CO.

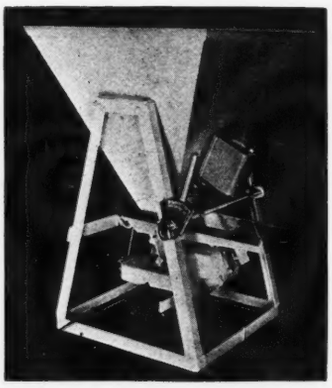
FULTON BLDG. PITTSBURGH, PA.

Breakers are available for front-of-board, drawout, back-of-board, and separate enclosure mounting.

Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.

Dry Feeder

MODEL FM-O-10 feeder is designed as piece of laboratory equipment and is used for feeding extremely fine materials or chemical re-agents. Rate of flow of material regulated by amplitudes of trough's electro-magnet vibrator, which is controlled by



rheostat. Hopper is kept free by small electro-magnet vibrator attached to one side preventing arching over and clogging up of material.

Syntron Co, 492 Lexington Ave, Homer City, Pa.

Unit Heater

IMPROVEMENTS in line of unit heaters include sound silencing, safety fan guard built into fan, and rust protection by Bonderizing process. Casing interior lined

with accoustical mastic, and velocity generator evens air flow through condenser and eliminates air-rush noise peaks. Illustration shows fan guard.

Modine Mfg Co, Racine, Wis.

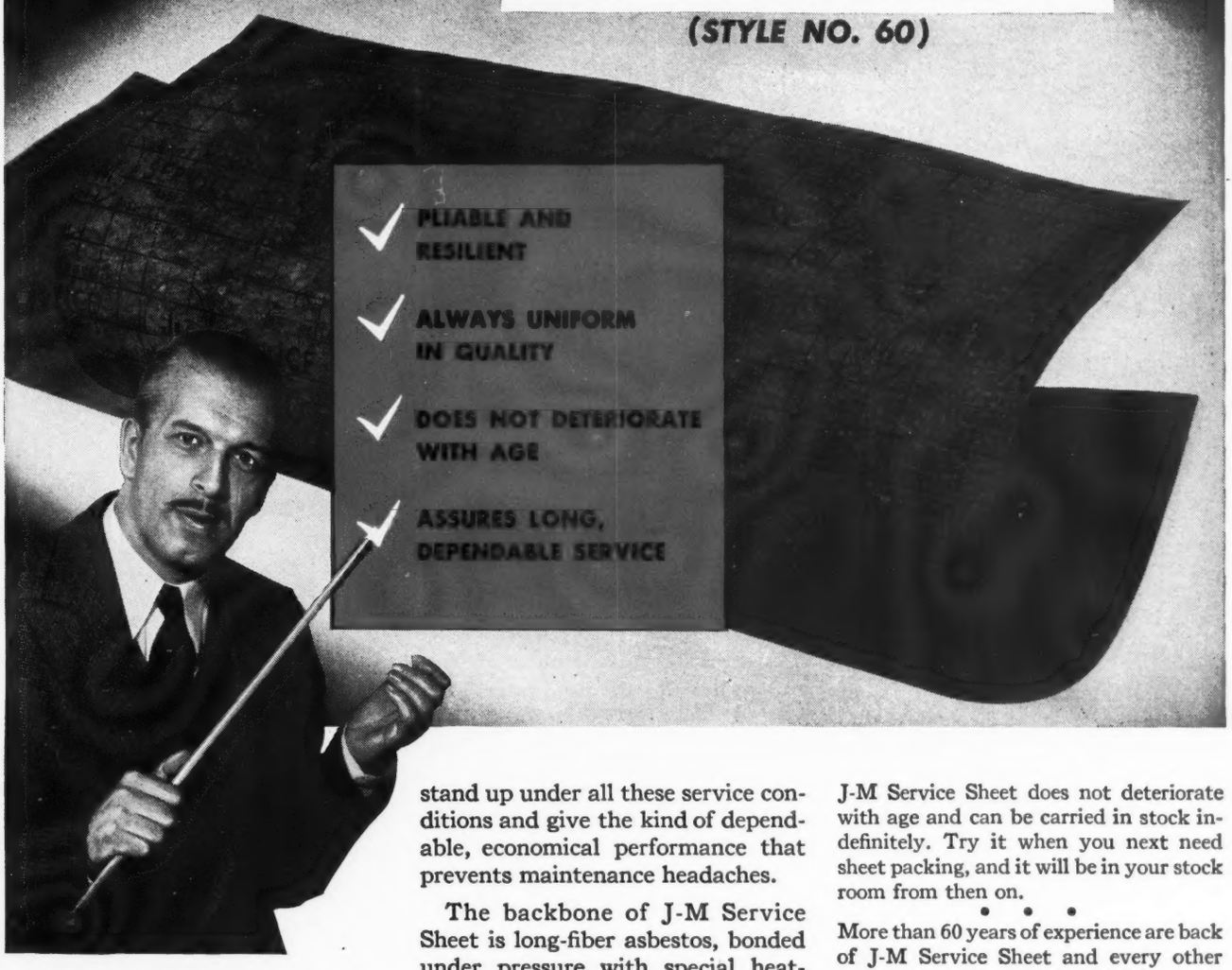
Pipe Bender

"PORTO-POWER" pipe bender handles 7 sizes of pipe, up to 4-in. in diameter. Comes in 2 sizes, larger size using 20-ton hydraulic unit, smaller size (pipes up to

"Here's a Sheet Packing you can count on!"

J-M SERVICE SHEET

(STYLE NO. 60)



WHERE do you use sheet packing? Against steam, gas, oil, air, water, ammonia, acids, alkalies or other chemicals?

Here's the asbestos sheet that will stand up under all these service conditions and give the kind of dependable, economical performance that prevents maintenance headaches.

The backbone of J-M Service Sheet is long-fiber asbestos, bonded under pressure with special heat-resisting compounds. It's pliable and resilient . . . always uniform in quality. One side is graphited; the other is ruled into one-inch squares to make measuring and cutting easy. J-M Service Sheet does not deteriorate with age and can be carried in stock indefinitely. Try it when you next need sheet packing, and it will be in your stock room from then on.

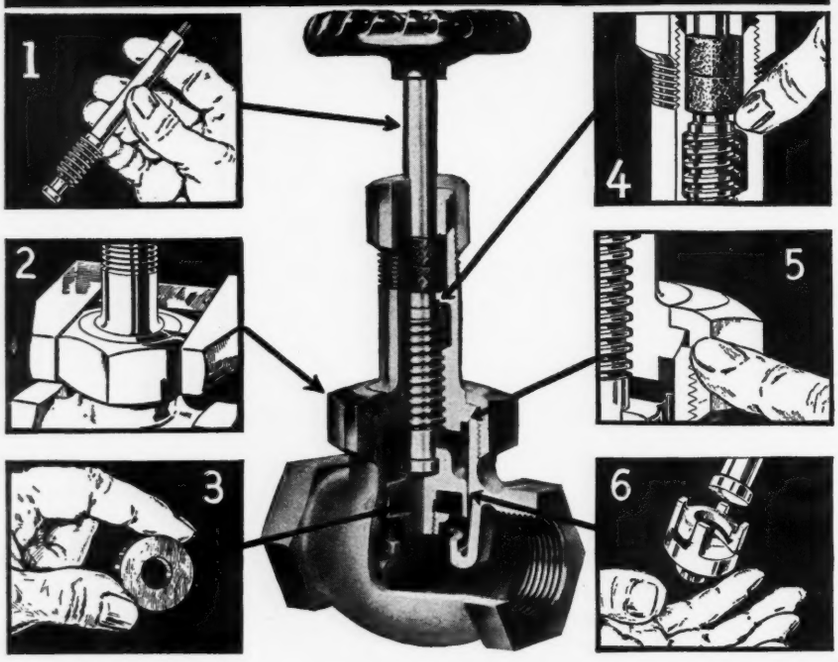
• • •

More than 60 years of experience are back of J-M Service Sheet and every other packing in the *complete* J-M Line. No matter what your packing problem may be, you'll find the answer in the J-M Packing Catalog. Better keep a copy in your desk. Write Johns-Manville, 22 East 40th Street, New York City.

JOHNS-MANVILLE

PACKINGS & GASKETS JUST PHONE YOUR NEAREST DISTRIBUTOR

These features assure easier renewal, lower maintenance cost, tighter joints and longer life.



1. The heavy, rolled-bronze rod stem has an average strength of 65,000 lbs. More than 5 threads are always in contact with bonnet.

2. The strong bronze union nut with large hexes offers a firm wrench grip and permits removal of bonnet without damage.

3. Composition Asbestos Disc Ring can be used for steam, hot water or cold water without cracking or flaking off. Extreme resiliency assures tightness.

4. Protected top seat above stem threads seats tightly on bonnet when valve is opened for repacking under pressure.

5. Radial seat insures a tight joint and perfect alignment of parts when new disc is inserted. No sliding or scraping of seating surfaces.

6. Slide-on disc holder drops off when valve is taken apart and makes it easy to change disc. Will not bind or stick regardless of position of valve. Any standard make of ring fits this holder.

Write for Catalog 21

THE FAIRBANKS CO.

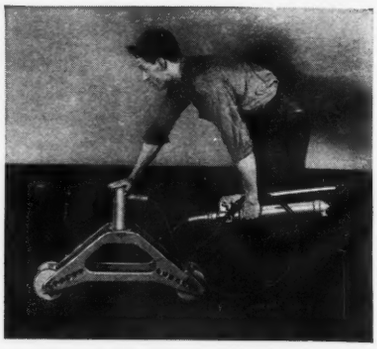
397 Lafayette St., New York, N. Y.

Boston, Pittsburgh

Distributors in Principal Cities

Factories: Binghamton, N. Y., Rome, Ga.

Fairbanks Renewable Valves

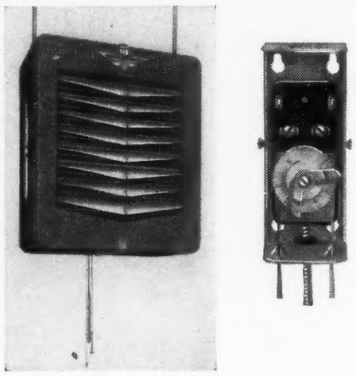


2 in. diameter) using 10-ton ram. Pivot shoes on larger model have wide rims, which act as wheels for rolling along on smooth surfaces. Ram is connected to hand-operated pump by 6-ft high-pressure hose.

Blackhawk Mfg Co, Milwaukee, Wis.

Unit Heater

"THERMOLIER" unit heaters now fitted with controls for both day and night temperatures. Heart of device is bulb-type thermostat containing solid liquid charge, mounted within heater housing. Two

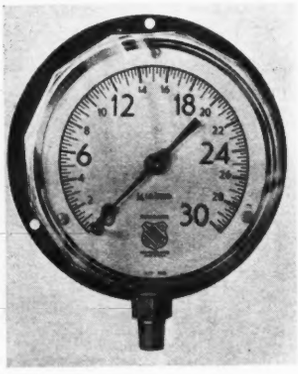


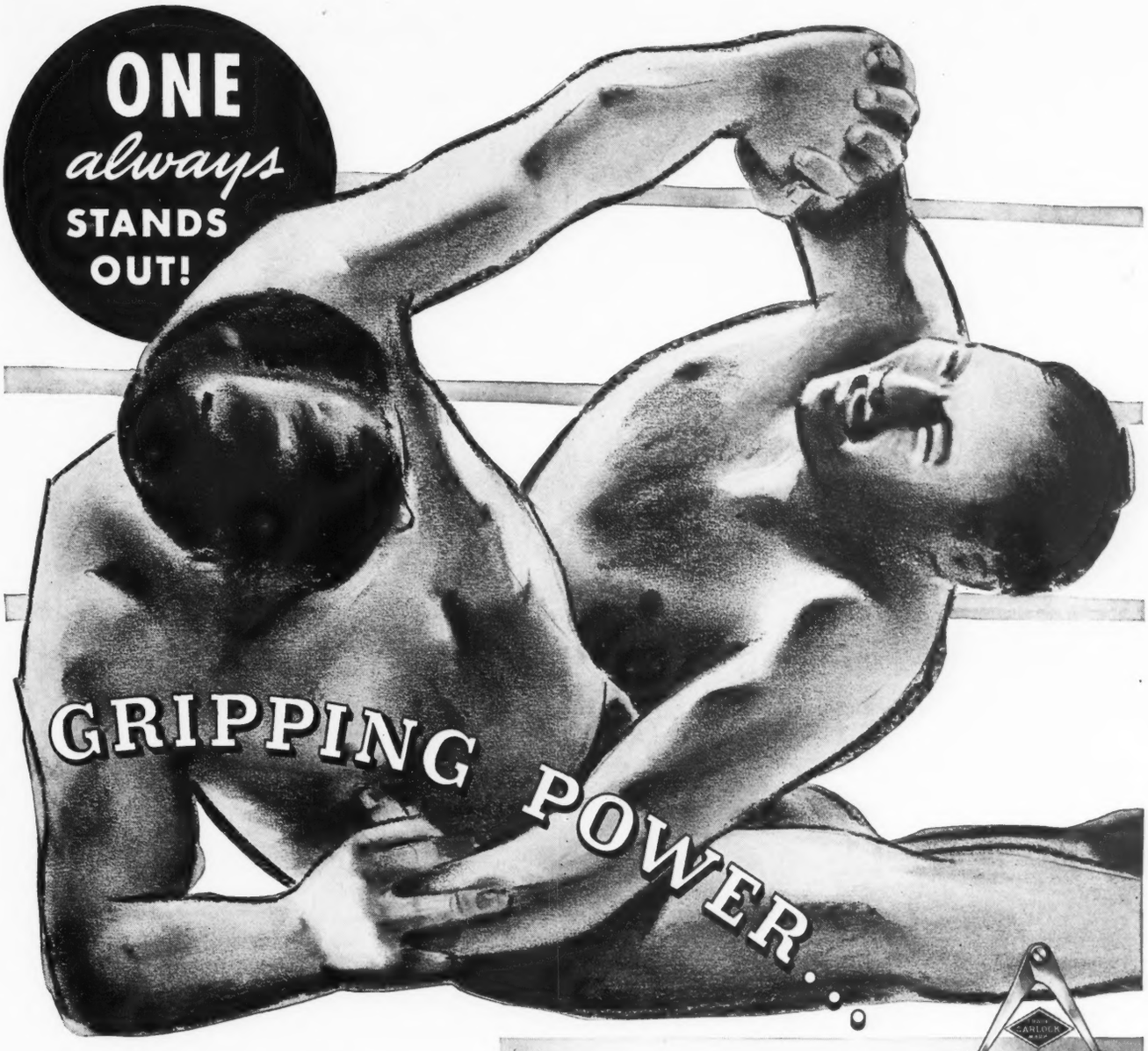
pointers—one for day and night—are adjustable over 60-deg range and locked. Thereafter, day and night settings are made by pull-cord control hanging from heater.

Grinnell Co, Inc, Providence, R. I.

Gage Cover

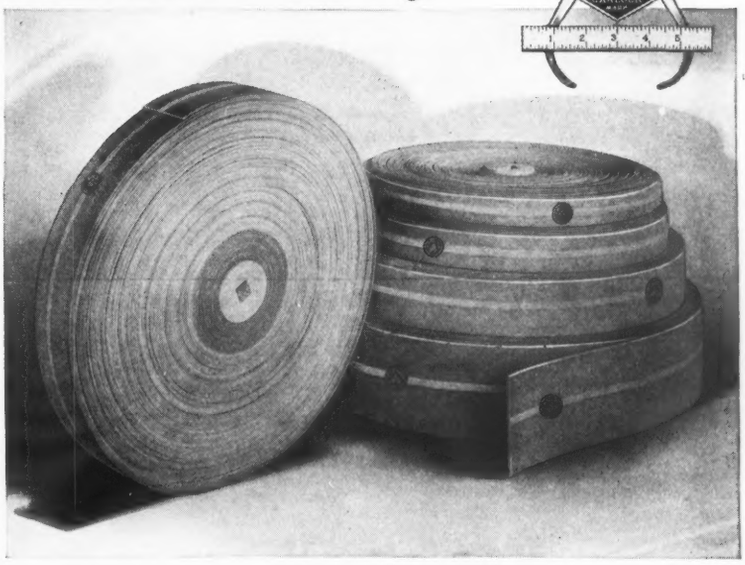
ASHCROFT non-breakable transparent plastic case threads into gage glass. Has tensile strength of about 5000 psi, and compression strength of 15,000 psi. Trans-





Garlock 725
RUBBER TRANSMISSION BELTING

Like the top-notch wrestler, GARLOCK 725 Rubber Transmission Belting has *exceptional gripping power*, coupled with *strength* and *endurance*. Constructed of high-grade duck, frictioned with Garlock special rubber compound, folded to size and cured under tremendous pressure, this flexible belting *holds fast*, and wears remarkably long. All standard belt sizes from 1-in. x 2-ply to 28-in. x 12-ply. Try it on your toughest job!



THE GARLOCK PACKING CO.
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

GARLOCK

Of course

—the fittings with the MOST advantages are the fittings that can be used to BEST advantage.

WeldELLS have these eight features that are combined in no other fittings.

TAYLOR FORGE & PIPE WORKS
General Offices and Works: P. O. Box 485, Chicago
New York Office: 50 Church St.

TAYLOR FORGE
WeldELLS
Seamless Pipe Fittings for Welding

1 SEAMLESS
2 UNIFORMLY FULL PIPE THICKNESS
3 SELECTIVE, UNIFORM REINFORCEMENT
4 TANGENTS
5 MACHINE TOOL BEVELLED
6 ENDS MARKED IN QUARTERS
7 COMPLETE IDENTIFYING MARKS ON EVERY FITTING
8 A FULL LINE

parent cover comes on 4½ and 6-in. phenol case Duragauges.

Ashcroft American Gauge Div, Manning, Maxwell & Moore, Inc, Bridgeport, Conn.

Multi-Breaker

TYPE MO serves as service center or load center for lighting, and can be supplied to control one or two circuits. Box can be furnished with grounded neutral, insulated

neutral, or no neutral. Furnished for either surface or flush mounting for 15, 20, or 25 amp.

Colt's Patent Fire Arms Mfg Co, Hartford, Conn.

Power Lines

(Continued from page 122)

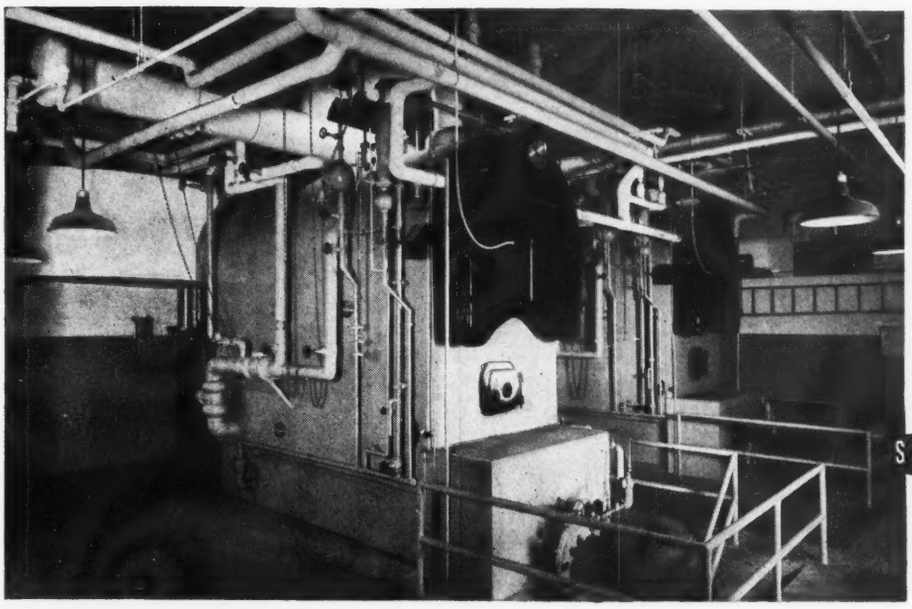
appointed administrator of the Rural Electrification Administration.

R B MOIR, who resigned recently as chief engineer of W A Jones Foundry & Machine Co, has become associated with Foote Bros Gear & Machine Corp as director of Sales Research & Engineering Development.

W F DALY, formerly in Chicago office, has been appointed district manager at St. Louis, of the Allis-Chalmers Mfg Co. Upon graduation from Pratt Institute in Brooklyn, and after post-graduate work at Columbia University, Mr Daly took the Allis-Chalmers graduate training course. He served as a lieutenant with the 37th Engineers in the last World War, and upon his return was transferred to Chicago office of Crocker-Wheeler Electric Co. He has been with the Allis-Chalmers Co since 1924.

OLIVER C SPURLING, for 30 years in charge of design and construction of Western Electric Co factories, has retired. He joined Western Electric in 1893 as a wireman's helper in New York, held several other positions in designing and constructing factories at Hawthorne, N.Y., Kearney, N.J., and Point Breeze, Baltimore, Md.

HARRY E KELLOGG has been elected treasurer to succeed Richard W Yerkes, who resigned recently, of the Link-Belt



Sears

SEARS, ROEBUCK AND CO.

K & M insulation conserves heat . . . . in Sears, Roebuck's Baltimore Building

In the Baltimore building of this efficiency-minded company, K & M insulation is doing its important part in the conservation and control of heat. Included in the installation, besides some 5000 linear feet of Air Cell pipe covering, are K & M's Duplex Woolfelt and Asbestos Cement.

You may be sure that K & M insulation was selected only after considerable "looking into." It was supplied by the Armstrong Cork Company, Keasbey & Mattison Distributor with headquarters in Philadelphia and Baltimore, whose service includes not only the supplying of quality insulation materials, but their correct application in a customer's plant. Armstrong has found that K & M insulation does its full part in building good will and clinching Armstrong's position in this highly technical field.

The Keasbey & Mattison advisory engineering service, in cooperation with K & M distributors, frequently produces unexpected economies that point the way to real savings in your plant. Why not write Dept. 11 for further details ?

K & M

AIR CELL INSULATION

KEASBEY & MATTISON

COMPANY, AMBLER, PENNSYLVANIA

The Sears, Roebuck installation is important confirmation of K & M's authority in the field of insulation. Since its founding 65 years ago, Keasbey & Mattison has expanded to a position of being trusted insulation consultants to industry on a national scale. Specializing from the start in Magnesia, and later in Asbestos products, K & M has been an innovator of improved materials, advanced methods and scientific application during the whole of its long life.

TRADE-MARK

"PALMETTO"

REG. U.S. PAT. OFFICE

A MODERN LUBRICATED PACKING

Made of Long Fiber Asbestos and Lubricated for Modern Temperatures for STEAM, COMPRESSED AIR AND BOILER FEED WATER

A GENERAL SERVICE PACKING

TWIST FOR VALVES

SEND FOR ABC CHART OF PACKING SERVICES NO OBLIGATION ON YOUR PART

BRAIDED FOR RODS

GREENE, TWEED & CO.

SOLE MANUFACTURERS

101 PARK AVENUE, NEW YORK

Company, Chicago, Ill. Mr. Kellogg has been closely associated with Mr Yerkes for the past 18 years, holding the positions of plant accountant, general credit manager, and chief accountant.

C E H PALMER of the Newark, N.J., office of General Electric Co, has been appointed manager of the company's New Haven, Conn., office. Mr. Palmer was born in Port Erie, South Australia, and attended Prince Alfred College of Adelside, South Australia. He entered the company in 1919 and the following year was made office engineer of the International General Electric Co. In 1923 he was transferred to the central station dept in the general office as commercial engineer. In 1930 he moved to the Newark office of the company.

GANO DUNN, president of the J G White Engineering Corp, and Cooper Union, has been chosen as 1939 recipient of the Hoover Medal, "awarded by engineers to a fellow engineer for distinguished public service". The medal will be formally presented to Mr Dunn under the auspices of the American Institute of Electrical Engineers during the annual convention in New York City, January 22-26, 1940. Mr. Dunn was born in New York in 1870. He received the bachelor of science degree from the College of the City of New York in 1889, the degree of electrical engineer from Columbia University in 1891, and the degree of master of science from C C N Y in 1897. He participated in the organization of the Engineering Foundation in 1915-16, and 1935 he became president of Cooper Union. He has been identified with numerous civic activities in New York City, is a trustee of Barnard College, and a former alumni trustee of Columbia University.

H W BUTTON, chief engineer for a number of years of the Laclede Power & Light Co of St. Louis, Mo., was elected vice-president in charge of operations. He has been connected with the Laclede Power & Light Co and affiliated companies for the past 13 years. He is a graduate of Worcester Polytechnic Institute, '12, and is member of the Sigma XI and Tau Beta Pi societies.

JOSEPH E OTIS, JR, was elected president of Dodge Manufacturing Co, Mishawaka, Ind., on October 2 to succeed George C Miller, who died May 10. Mr Otis came to Dodge Mfg Co from the presidency of Stewart-Warner Corp, which he had held since 1933. Prior to that, he was for ten years vice-president and general manager of Alemite Corp.

OBITUARIES

LIEUT FRANCIS HILL, M M, 52, of Vancouver, B. C., died recently in Shaughnessy Military Hospital, Vancouver. Born in England, he was a well known engineer, and was associated with such projects as the B C E R power plants at Ruskin and Stave Lake, and the Lions Gate Bridge.

EDWIN C HATHAWAY, 78, former assistant general manager of the Virginia Electric & Power Co, and general manager of the

New "RPM" DELO

(Diesel Engine Lubricating Oil)

GIVES YOU MORE "DIESEL PER DOLLAR!"

Smoother break-ins. *Longer* peak power performance. *Cleaner* engines. Definitely *lower* wear-rate. *Rock-bottom* operating costs. These are what you want—and exactly WHAT YOU GET with New "RPM" DELO!

Let's look at the record at the end of these tests:—All pistons, rings and skirts in *excellent* condition; oil filters *unclogged;* bearings mirror-smooth, clean, and—*no* sign of corrosion.

Long tests—full-load tests—grueling tests in your own Diesels will confirm this experience of 99,000 hours of testing. New "RPM" DELO's unequaled lubrication will give you *more trouble-free Diesel performance for your money.* Try it—and see.

New "RPM" Diesel Engine Lubricating Oil now available everywhere in the gray barrel with the blue head

Unequaled **for every Diesel**

Order from Your Nearest Distributor as Listed Below:

IN THE UNITED STATES

"RPM" Diesel Engine Lubricating Oil:
The California Company (Montana only)
Humble Oil & Refining Company
Standard Oil Company (Indiana)
Standard Oil Company (Nebraska)
Standard Oil Company of California
Standard Oil Company of Texas
Utah Oil Refining Company

Diol "RPM" Diesel Engine Lubricating Oil:
The Carter Oil Company
Tulsa, Oklahoma
Colonial Beacon Oil Company
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey
Standard Oil Company of Pennsylvania

Kyso "RPM" Diesel Engine Lubricating Oil:
Standard Oil Company (Inc. in Kentucky)

Signal "RPM" Diesel Engine Lubricating Oil:
Signal Oil Company

Sohio "RPM" Diesel Engine Lubricating Oil:
The Standard Oil Company (Ohio)

IN CANADA AND NEWFOUNDLAND

New Imperial "RPM" Diesel Engine Lubricating Oil:
Imperial Oil Limited

IN BRITISH COLUMBIA, ALBERTA AND SASKATCHEWAN

New "RPM" Diesel Engine Lubricating Oil:
Standard Oil Company of British Columbia Limited

THROUGHOUT THE WORLD
"RPM" Diesel Engine Lubricating Oil is available in more than 100 countries.

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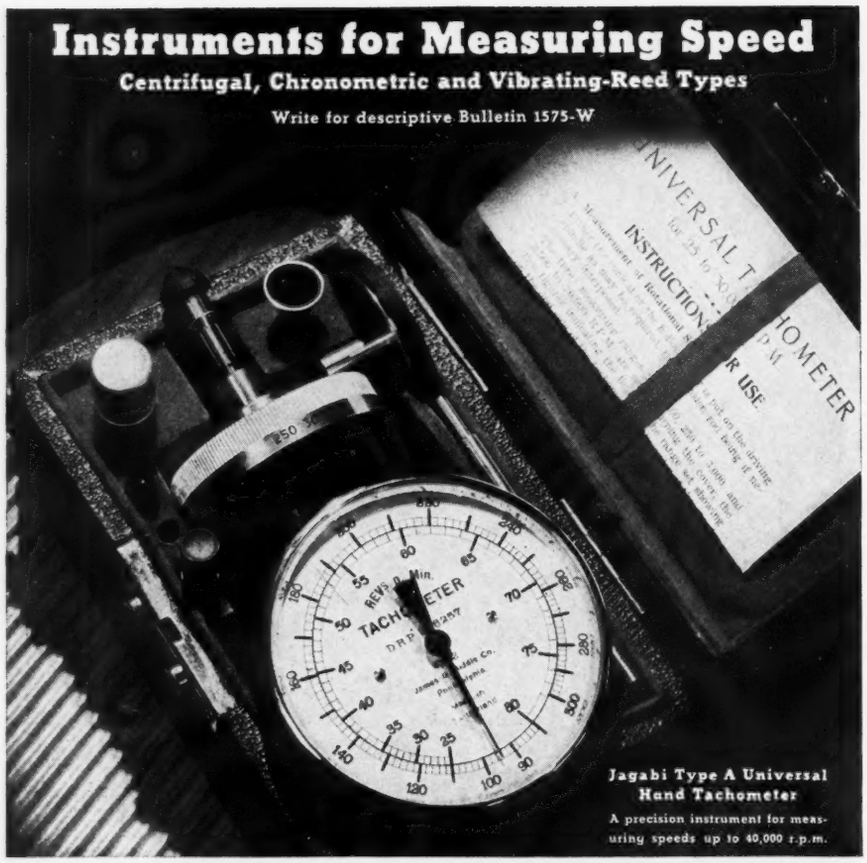
DIESEL ENGINE LUBRICATING OIL

STANDARD OIL COMPANY OF CALIFORNIA

Instruments for Measuring Speed

Centrifugal, Chronometric and Vibrating-Reed Types

Write for descriptive Bulletin 1575-W



Jagabi Type A Universal Hand Tachometer

A precision instrument for measuring speeds up to 40,000 r.p.m.

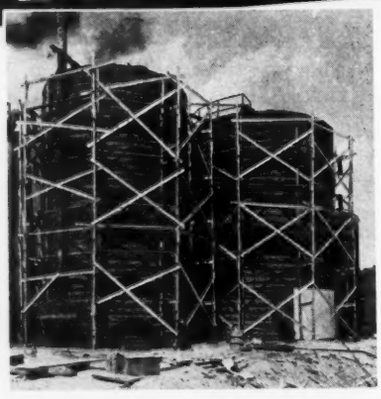
JAMES G. BIDDLE CO.

1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

Cut Power Losses . . . .
Reduce Fuel Costs with

B-H

BALDWIN-HILL



B-H ROCKWOOL BLANKET

For large areas, effective up to 1200° F. Rockwool is carefully felted between various types of metal fabrics and forms continuous blanket of insulation without joints or cracks.

HEAT INSULATION PRODUCTS

Look to B-H engineered insulations made in a complete line to meet every industrial need for the greatest heating efficiency and maximum fuel savings.

Write for Catalog to

BALDWIN-HILL CO.

575 Klagg Ave., Trenton, N. J.

Portsmouth Traction Co until 1911, died recently at his home in Patten, Me. He remained with the traction company for several years before it was taken over by the Virginia Electric & Power Co, and had returned to his home in Patten after his retirement.

PERCY E BLOOD, 66, president of the Niagara Falls Power Co for 10 years, died at Niagara Falls after a brief illness. He was born at Brocton, Mass., and was graduated from the Massachusetts Institute of Technology in 1895. He came to Niagara Falls 21 years ago, was first in charge of the drafting department, later being resident engineer.

BUSINESS ITEMS

SPENCE ENGRG CO, INC, New York, N.Y. has acquired by purchase the plant and business of the Rider-Ericsson Engine Corp at Walden, N.Y. This plant was founded by Capt John Ericsson, builder of the "Monitor", inventor of the screw propellor and hot-air engine, in 1842. Spence Co will continue to furnish repair parts for Rider-Ericsson engines and pumps, but plant will be devoted to manufacture of Spence regulators.

STANLEY ENGRG CO, recently organized by C Maxwell and Arthur E Stanley, has acquired practice of Young & Stanley, Inc, of Muscatine, Iowa, and will continue in general practice of engineering.

INDUSTRIAL EQUIPMENT DIV, CONTINENTAL ROLL & STEEL FOUNDRY CO, East Chicago, Ind., has acquired the Howell Engrg Co, St. Charles, Ill., and will manufacture the Howell stokers made under the B F Bower patents and patents pending. The engineering, sales, and service staffs of the Howell Co have become a part of the Continental organization.

QUAKER CITY RUBBER CO, Philadelphia, Pa., announces opening of new branch office at Houston, Texas. H M Sossaman will be in charge of the branch, which will have its office at 201 San Jacinto St. The Houston branch will serve the states of Arkansas, Louisiana, Mississippi, New Mexico, Oklahoma and Texas.

Meetings

American Society of Heating & Ventilating Engineers—*Annual Meeting in conjunction with 6th International Heating & Ventilating Exposition, January 22–26, 1940, Lakeside Hall, Cleveland, Ohio. A V Hutchinson, secretary, 51 Madison Ave, New York, N. Y.*

American Society of Mechanical Engineers—*Annual Meeting, December 4–8, Philadelphia, Pa. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

American Society of Refrigerating Engineers—*35th Annual Meeting, January 16–18, 1940, Blackstone Hotel, Chicago, Ill. David L Fiske, secretary, 37 W 39th St, New York, N. Y.*

Eastern Air-Conditioning Conference—*November 10–11, Lehigh University, Bethlehem, Pa. ASRE cooperating; write David L Fiske, ASRE secretary, 37 W 39th St, New York, N. Y., for details.*

Refrigeration Service Engineers Society—*Annual Convention, January 15–18, Chicago, Ill. H T McDermott, secretary, 433 N Waller Ave, Chicago, Ill.*

SORRY—

NO GOOSE GREASE

A COAL-MINE car journal and a skip-drum bearing *both* need lubricating. And neither does well on makeshifts.

A crusher gearbox and a centrifugal pump shaft; a ship's stern tube and a bucket-conveyor tumbler—the list is a yard long and there are also variables in operating conditions and mechanical design which may change lubrication specifications a score of times in one company.

Now—while we don't supply "goose grease," we *do* have scores of different greases in the Shell line. There is a right grease for every lubricating need. It costs no more than the wrong grease and usually costs less.

After all, it is not how much a plant can save on its grease bill; it is the dollars saved on repairs, replacements and shutdowns and the dollars saved on reduced friction which really count.

The services of Shell's lubrication specialists go along with its complete line of greases. This staff, thoroughly trained in solving lubrication problems, is available without charge anywhere in America.

SHELL

SHELL INDUSTRIAL GREASES

NICHOLSON

HIGH PRESSURE WELDED FLOATS – Stainless Steel-Chromium Plated Steel

Available for all applications—for steam pressures up to 1500 lbs. and hydrostatic pressures up to 2500 lbs.—for corrosive and non-corrosive service.

Made in spherical and elliptical shapes in sizes from 2½" to 14" diameter. High in tensile strength and offer great resistance to external pressure. Special sizes and shapes available to order, and also cadmium, nickel or copper plated. Fully described in Bulletin No. 339.

2-, 3- or 4-WAY CONTROL VALVES for SINGLE and DOUBLE ACTING CYLINDERS

Special types also available.

Designed for long life, quick and dependable control of air, steam, oil, gas or water on pressures up to 300 lbs.

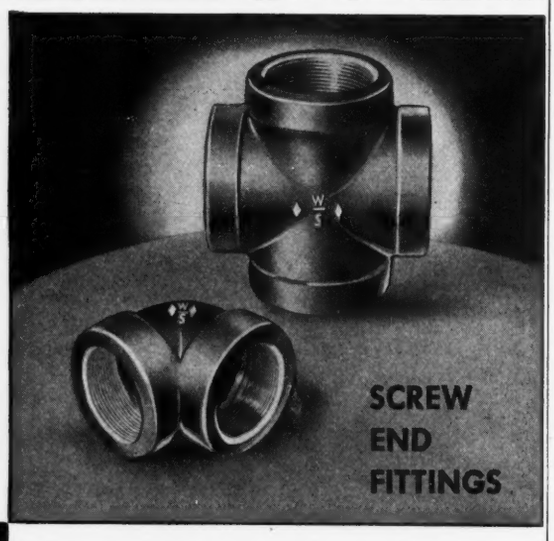
Made also in foot, solenoid and motor operated types—also balanced valves for high pressure hydraulic service. Ask for Bulletin No. 933 for details.

OTHER PRODUCTS

NICHOLSON Industrial Steam Traps, Piston and Weight Operated Traps, Flexible Couplings, Expanding Mandrels, Arbor Presses, Compression Shaft Couplings, Steam Eliminators and Separators, Compressed Air Traps.

W. H. NICHOLSON & COMPANY
WILKES-BARRE PENNSYLVANIA, U.S.A.

W-S FORGED STEEL FITTINGS *for* HIGH TEMPERATURE HIGH PRESSURE SERVICE



Wherever pipe lines carry steam, water, oil, gas or ammonia—under high pressures and temperatures—you can depend on W-S Forged Steel Fittings for safety, long life and low maintenance.

W-S Fittings are bored from solid forgings with openings equal in area to the bore of the pipe, thus assuring free flow. Walls are of uniform thickness and because of the forging process are of dense structure, free from defects.

W-S Fittings are available in Welding and Screw End Types in a wide range of sizes. The Watson-Stillman Co., Roselle, N. J.

WATSON W-S STILLMAN

Readers' Problems

(Continued from page 110)

assumption that the engine will operate at its rated load of 60 kw output for 8 hours per day and 300 operating days per year. At this rate of output, the saving in hydro power will be 60 × 8 × 300 = 144,000 kwhr per year.

Saving in cost will be 144,000 × 0.03 = $4320.00 per year. To obtain this saving, extra cost of operating the engine and generator must be deducted. This is estimated as follows:

Heat equivalent of 1 kwhr = 3415 Btu.

If engine and generator efficiency is 80%, heat supplied by steam to indicated work = 3415 ÷ 0.80 = 4270 Btu per kwhr.

Probable heat loss due to radiation from engine, piping, traps, etc, will be approximately 15%.

Heat given up by steam in passing through engine = 4270 ÷ 0.85 = 5000 Btu per kwhr.

It is most probable that in this case the boilers generate steam without superheat. In a perfect engine with complete adiabatic expansion from 125 to 15 lb, the steam consumption will be approximately 50 lb per kwhr, which assumes an efficiency ratio of about 60%. Since the steam gives up 5000 Btu per kwhr to engine, the heat given up per lb of steam will therefore be 100 Btu and the exhaust from the engine will be wet. The amount is estimated as follows:

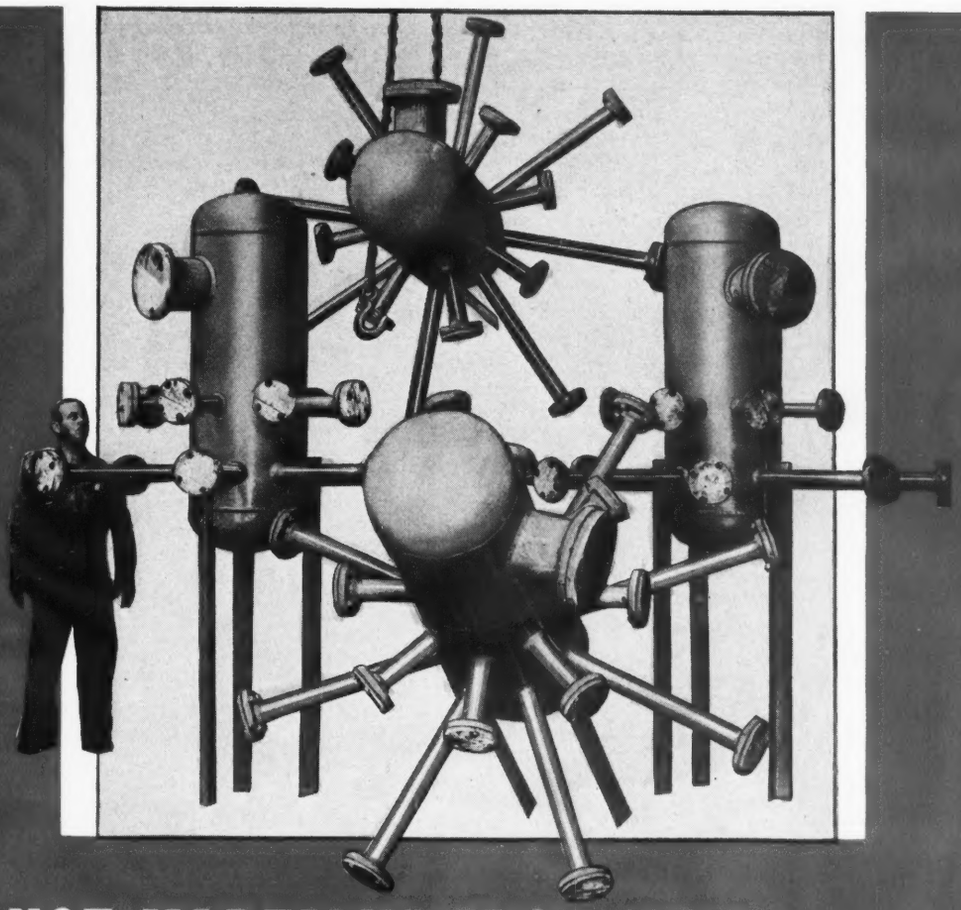
Heat per lb initial steam at 125 lb g	1192.2 Btu
Heat per lb exhaust steam at 15 lb g	1092.2 Btu
Heat per lb moisture in exhaust	218.8 Btu
Therefore, latent heat per lb exhaust steam at 15 lb g	873.4 Btu
And latent heat per lb dry steam at 15 lb g	945.1 Btu
Therefore, dryness of exhaust steam = 873.4 ÷ 945.1 =	.924 Btu

This means that the exhaust steam will contain about 7.6% moisture; a steam separator and trap would be advisable. If the trapped moisture can be sent directly to the hot-well there will be no loss, but if, as in many cases, this moisture is dumped to the sewer on account of oil contamination there will be an additional heat loss. The amount of water will be 50 × .076 = 3.8 lb per kwhr and the temperature 250 F. The total loss will therefore depend on the makeup temperature. Assuming this to be 60 F the heat loss will amount to 3.8 × 190 = 722 Btu per kwhr. The total heat given up by steam in passing through engine = 5000 + 722 = 5722 Btu per kwhr.

This amounts to (5722 × 144,000) Btu in 1 year.

If boilers have no economizers the efficiency will be approximately 70% and extra coal burned for power generation, assuming 13500 Btu per lb coal, will be (5722 × 144,000) ÷ (0.7 × 13,500) = 87,200 lb.

The cost of extra coal at $6.30 per ton will be (87200 × 6.30) ÷ 2000 =		$275.00
Present cost of hydro power @ 3 cents per kwhr. =		$4320.00
Coal cost of generating power with engine per year	$275.00	
Cost of lubrication for engine and generator per year	60.00	
Cost of labor (1 man @ 50 cents per hr.)	1200.00	
Total	$1535.00	



NOT MARTIANS FROM MARS—— BUT PIPE HEADERS FROM KELLOGG

These strange looking pipe headers were not inspired by H. G. Wells' "War of the Worlds." They were designed and prefabricated to perform a particular function for a Kellogg customer.

Prefabricated complete in the Kellogg Shops, these headers were shipped ready to connect on the job. They are made of 20" O.D. pipe, 3/8" thick, and are fitted with 17 accurately located nozzles—"Masterwelded" to the main shell.

The high quality of Kellogg shop-welding and the skill of Kellogg craftsmen are convincingly demonstrated in these headers.

If you have an unusual piping problem consult a Kellogg Engineer.

KELLOGG

THE M. W. KELLOGG COMPANY

JERSEY CITY · NEW JERSEY · 225 B'WAY, N. Y.

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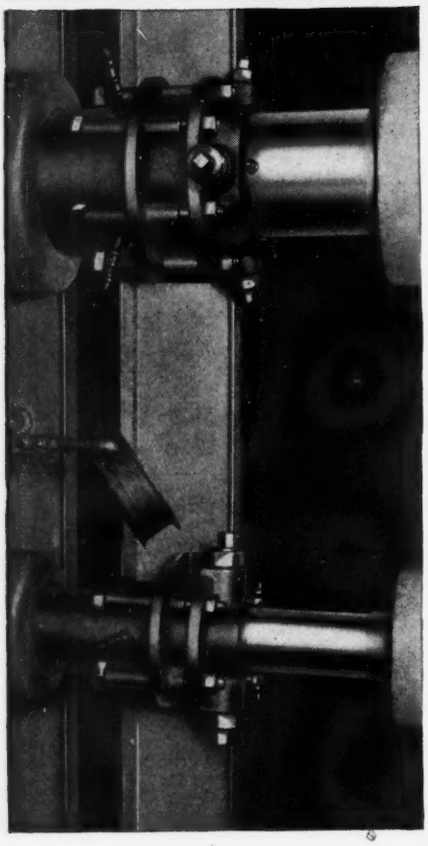
"Masterflex" Prefabricated Piping Systems · **"Masterweld"** pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic Cracking Units. Thermal and Catalytic Polymerization Units · **JUIK Processes** for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

YARWAY
GUN-PAKT EXPANSION JOINTS



Big Automobile Company Uses 67 Yarway Joints

First purchased 3 years ago. Reordered 7 times to present total of 67 Yarway Gun-Pakt Joints, ranging in size from 3 in. to 14 in.

Why don't you select the Expansion Joint that is packed under full steam pressure. A twist of a wrench forces a special semi-plastic packing into the stuffing box by means of integral pressure guns. No need to remove old packing. New packing rejuvenates the old. No need to shut off steam. Write for Catalog EJ-1906.

YARNALL-WARING CO.
100 Mermaid Ave., Phila., Pa.

Capital Charges	
Annual interest @ 6% on $3,000.00	180.00
Depreciation 10 yrs @ 5%	238.00
Total	418.00
Total charges on power generation by engine =	$1953.00
Annual saving by investing in engine	$2367.00

From the above it is evident that it will pay to spend $3000.00 on an engine installation provided that it will operate as assumed above. Any increase in time of operation will increase the savings obtainable and vice versa. It should be noted that the engine consumption of steam at its rated output of 60 kw. will amount to about 3000 lb steam per hour and it is assumed that the amount of process steam in continual demand will be equal to or greater than this amount. If at any time the exhaust from the engine cannot be absorbed in process, the picture will be changed, as this is very important.

Allowance has been made above for additional labor cost. This may not be necessary as it may be possible for present boiler room operator to look after engine.

Sault Ste. Marie, Ontario J HARDIE

Construct a Chart

S S HAS NOT STATED in his problem the following important items: (1) number of hours of plant operation, (2) type of electrical load, (3) maximum and average kw demand, (4) monthly energy consumption in kwhr, (5) amount of exhaust steam that can be used, (6) ability of present personnel to operate engine-generator set, (7) boiler efficiency, and (8) standby charges and costs for night lighting.

Assuming that all exhaust steam can be utilized, that boiler efficiency is 65%, and that it will be unnecessary to add to operating personnel, a chart showing cost of electricity purchased and cost of generation for various kwhr consumptions per 8-hr day can be constructed. Assume 6% interest per year on $3000 investment and fixed operating and maintenance incidentals of $150 per year. Fixed costs will be $510 per year or $1.96 per working day (5-day week). Cost of standby service and night lighting is estimated at $600 per year.

Canton, Ohio E J MERKEL

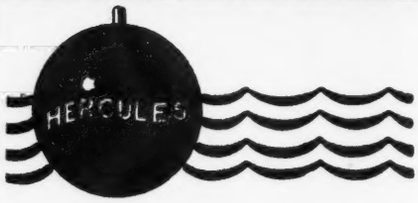
Kwhr per 8-hour day	Cost of purchased elect	Fixed costs, generat	Pounds of coal char. to gen	Cost of coal chargeable to gen
440	$13.20	$1.96	264	$0.86
400	12.00	1.96	240	0.78
320	9.60	1.96	195	0.64
240	7.20	1.96	149	0.49

Total costs, gen	Savings per day	Savings per year of 261 work days	Standby and night lighting	Net savings per year
$2.82	$10.38	$2710	$600	$2110
2.74	9.26	2415	600	1815
2.60	7.00	1825	600	1225
2.45	4.75	1240	600	640

How to Make Survey

WHILE KWHR GENERATED by utilizing exhaust steam are to some extent a cheap source of electrical energy, much depends

HERCULES
Seamless Copper
FLOATS



GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process, Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

Save Air—Save Dollars
ROCKWELL BLAST GATES

Threaded Slide Type

Flanged Slide Type

For Low Pressure Air
•
Slide Type
Butterfly Type
Kwikleen Type
•
Write for catalog No. 3760
•

W. S. ROCKWELL COMPANY
50 CHURCH ST., NEW YORK

Do the lubricants you are using possess the *Essential Qualities* you need?

Effects of slight differences in oil quality, readily demonstrated by Gulf Research technologists, may have a great influence on the profitable operation of your machinery.

This sensitive machine in the Gulf laboratory is used to measure differences in friction for oils applied to bearing surfaces in various ways. It also shows how much of the qualities popularly known as "oiliness" and "film strength" an oil possesses.

TWO oils may look exactly alike, may have the same "specifications." But, subjected to high operating temperatures, one may depreciate more rapidly than the other and fail to protect bearings against wear and replacement.

How can you be sure you are using lubricants which possess the essential qualities modern research and advanced refining methods have made possible today? Ask a Gulf engineer to check over your equipment and recommend the oils and greases exactly suited to each bearing, gear, and moving part. Then see that his recommendations are adopted. Thus you can insure smoother machine operation, greater productivity and lower maintenance costs for all your equipment—benefits that cannot be predicted in an oil specification.

In 30 states from Maine to Texas, Gulf offers this cost-reducing lubrication service to public utilities, railroads, industrial and marine operating companies. More than 1100 Gulf warehouses make these higher quality oils and greases quickly available to you. Write or phone your nearest distributing point today... Gulf Oil Corporation—Gulf Refining Company, Gulf Building, Pittsburgh, Pa.

Maintenance Costs Reflect Lubrication Efficiency

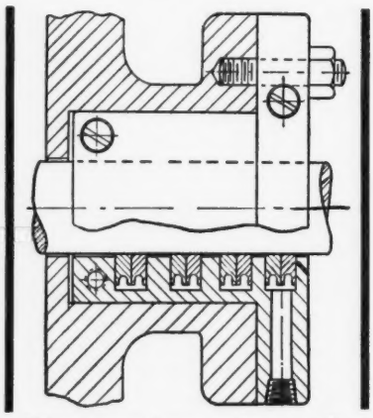
Small Diesel plant superintendent says: "We've reduced maintenance costs 66⅔% since we adopted Gulf's higher quality Diesel lubricants. Now we are able to run through a whole summer season without any of the operating troubles we previously experienced."

The superintendent of a large Diesel power plant says: "We're saving $350.00 per month—sliced from our maintenance bill since we accepted this Gulf engineer's recommendations and placed Gulf's higher quality Diesel oils in service."

GULF INDUSTRIAL LUBRICATION

ALSO A COMPLETE LINE OF FUEL AND FURNACE OILS

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide
KEEP YOUR MEN OFF LADDERS—
control valves from the floor
With Babbitt Sprocket Rims on your overhead valves, you can control valves instantly from the floor. Far quicker and safer than climbing ladders.
Babbitt Rims are easily attached in a few minutes, are inexpensive and assure safe, positive and instantaneous overhead valve operation. Available for valves of every make or style. Write for details.
BABBITT STEAM SPECIALTY CO.
New Bedford Mass.



...Wears as long as any other working part of the engine

France is "full-floating" metal packing for piston rods and valve steams in any type of engine, pump or compressor. Prevents rod scoring and provides maximum sealing efficiency under any condition of speed, pressure or temperature. Write for details.

THE FRANCE PACKING CO.
Tacony, Phila., Penna.
Branch Offices in Principal Cities

Original FRANCE METAL PACKING

F&E Hydraulic Powered UNDERFEED STOKERS

This exclusive Five-Feature Combination assures dependability, efficiency and fuel economy.

1. Unit Type Electro-Hydraulic Drive
2. Interval Timer Governor (patented)
3. Sliding Bottom Retort
4. Fuel Bed Regulator
5. High Efficiency Tuyeres

F&E
Flynn & Emrich Co.
ESTABLISHED 1842 BALTIMORE, MD.

on the individual plant, as hardly any two manufacturing plants are the same.

The most important data required are (1) steam requirements for 125- and 15-lb pressure, and heating, (2) time of plant operation (hours use of electrical and steam equipment, (3) duration and possible peaks of present hydro supply, and (4) cost of water, attendance, miscellaneous supplies.

To obtain above information, S S should do the following: (1) Install (rent) a steam flowmeter and determine steam flow in each system. (2) Average daily hours of plant operation, also weekly. (3) Read demand meter of present service for a daily demand curve. (If no demand meter is installed, read rpm of watthour meter and use constant to get demand in kw). (4) See present water bills. Will an engineer be required? Depreciation charges if any?

A very rough estimate, based on the following data, can be given to show the general application of exhaust for power generation:

Electric:

Demand peak—50 kw.

Energy consumption—10,000 kwhrs per month (200 hours use of demand per month).

Cost—$300.00 per month (at 3¢ per kwhr including service charges.) $3600.00 per year.

Steam:

Process and heating for 7 months = 275,000 lb per month = approx. 2000 lb per hour. Based on a water rate of 35 lb per hp, 2000 lb of steam will produce approx. 50 kw at 15 lb backpressure of engine. At 200 hours of plant operation, engine exhaust will generate 10,000 kwhr per month. If not sufficient process steam is required during remaining 5 months of the year, standby service will be necessary, also for night lighting, as otherwise exhaust will go to atmosphere, wasting fuel and increasing power costs.

Conclusion:

If steam requirements are such as to make use of all engine exhaust, savings from $500. to $1000. might be realized. Before buying the engine a thorough survey is necessary.

New York, N. Y. O SAUTER

STRAWS

Pointing the way business winds blow

ALABAMA——Tallapoosa County Farmers' Exchange, Dadeville, approved plans for 1-story cold-storage and refrigerating plant, with locker system of about 200 units. Cost about $30,000 with equipment.

ARIZONA—— Bureau ,of Reclamation Phoenix, has low bid from Clyde W Wood, 208 West 8th St, Los Angeles, Calif., at $276,210 for construction of power plant, steel tunnel supports and appurtenant work for hydroelectric power station at Parker Dam, Parker Dam Project, Ariz.-Calif., about 15 mi from Earp, Calif., and will make award soon. Bid is exclusive of power plant equipment, for which awards will be made separately.

CALIFORNIA——Burbank plans municipal steam-generating plant, estimated to

Pressure piping pre-fabricated by a qualified pipe fabricator is delivered to the job in a series of sub-assemblies that are commercially practical, heat-treated or stress-relieved when necessary, shop tested, accurately aligned, thoroughly cleaned and inspected . . . all essential to rapid and economical erection.

Specialized piping experience enables the qualified fabricator to contribute suggestions that frequently simplify layout and reduce costs.

The many facilities (work rotating fixtures, straightening tables, pre-heating equipment, etc.) available only in the qualified pipe fabricating plant, and the use of pressure welders whose work is subjected to rigid inspection and periodic physical test, assures welding that is of superior quality and can be insured.

Use pre-fabricated piping on your next pressure piping job. Its many important advantages cannot be disregarded by the smart purchaser.

THE PIPE FABRICATION INSTITUTE

P.F.I. THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

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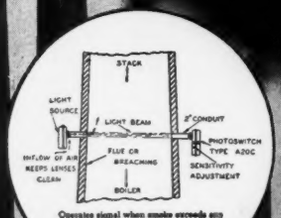
PHOTOSWITCH
Electric Eye
INCREASES FUEL ECONOMY—AVOIDS SMOKE NUISANCE



Operates signal when smoke exceeds any predetermined density

Sketch of Typical Installation

DEPENDABLE—RUGGED
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SOLVES YOUR OTHER CONTROL PROBLEMS

Wherever objects are counted, electrical machinery automatically controlled, or warning signals are used, PHOTOSWITCH will do the job better and more economically.

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NEW ODOR ABSORBER

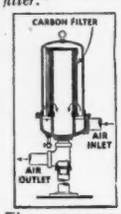
REMOVES *Odors, Gases, Oil Vapors*
FROM COMPRESSED AIR LINES

You can now eliminate contamination of products and have complete freedom from odor troubles—by actually removing odors, oil vapors, fermentation vapors and other objectionable gases from compressed air with the DOREX Pipe Line Odor Adsorber. This new development is a simple auxiliary air stream "filter" of activated coconut shell carbon—a powerful commercial adsorption agent which will adsorb and hold odors up to 15-20 per cent of its own weight.

The "filter" unit is readily installed at any desired point in the air line. Standard sizes are available for handling compressed air capacities from 12 to 560 c.f.m., and pipe connections are available from 1" to 6".

If you want compressed air free of all odors, vapors and similar impurities, many of which cannot be eliminated by filters, commercial separators, aftercoolers or scrubbers, write us today outlining your problem.

Strong cast outer shell houses the special "odor-filter."



There are no moving parts—nothing to get out of order.
(Pats. pend.)

IF YOU HAVE AN ODOR PROBLEM OF ANY KIND—SEND FOR OUR BOOKLET ON ODOR CONTROL

DOREX

DOREX AIR CONDITIONING DIVISION
W. B. CONNOR ENGINEERING CORP.
116-A East 32nd Street, New York, N. Y.

cost about $800,000, for which bond issue of $350,000 has been voted for initial work. Contract will be let soon for boiler unit and accessories with rated capacity of 120,000 lbs per hr. H I Stites, city manager, in charge.

Bureau of Yards and Docks, Navy Dept, Washington, D. C., contracted Cory & Joslin Contracting Engineers, Inc, 50 Hawthorne St, San Francisco, at $196,500 for installation of power equipment and piping in power plant at naval air station, Alameda (Specifications 8619).

Consolidated Aircraft Corp, 3302 Pacific Highway, San Diego, plans group of 1-story plant units for parts manufacture and assembling on 17-acre tract of tidewater property recently leased from city. Cost reported close to $600,000 with power equipment and machinery. Edward C Taylor, 803 West 3rd St, Los Angeles, architect.

Long Beach Ice Skating Rink, West Anaheim St, Long Beach, plans refrigerating plant for new ice-skating rink, 100 x 150 ft, on adjoining site. Bids scheduled to be asked soon. **Francis H Gentry,** Jergins Trust Bldg, engineer.

Glendale contracted General Electric Co, Schenectady, N. Y., at $390,840 for steam turbine-generator for municipal power plant (Specifications 202-B). Also has low bid from Terry Steam Turbine Co, Hartford, Conn., at $30,000 for one 1500-kw steam turbine-generator and accessories (Specifications 213), and low bid from Robert L Johnson Co, Monadnock Bldg, San Francisco, at $269,216 for 2 high-pressure boilers, with rating of 200,000 lbs per hr, including superheater, air heater, oil burners and accessories. Awards will be made soon.

CONNECTICUT——Hat Co. of America, Inc, Norwalk, has approved plans for boiler house at factory. Cost estimated close to $25,000 with boiler units and accessories. Fletcher-Thompson, Inc, 1336 Fairfield Ave, Bridgeport, architect and engineer.

DELAWARE——E I du Pont Nemours & Co, Inc, du Pont Bldg, Wilmington, Rayon Div, plans additional production unit at new synthetic fiber mill at Seaford, now in course of erection and scheduled for completion by close of this year. Includes several multi-story buildings, reported to cost over $3,500,000 with machinery and power equipment.

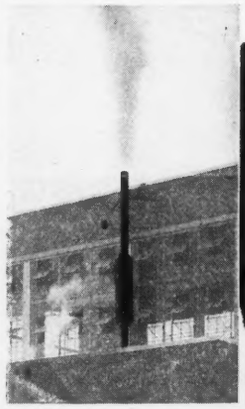
FLORIDA——Pensacola plans 1- and multi-story cold-storage and refrigerating plant for service at new fruit terminal building to be erected on adjoining site. Cost about $370,000 with equipment. Bond issue is being arranged in that amount.

Dade County Bd of Public Instruction, 275 N W 2nd St, Miami, plans central-heating plant in new 3-story junior high school on S W 19th St, for which bids will be asked soon. Cost about $300,000. August Geiger, 731 Lincoln Rd, architect.

Florida Pulp & Paper Co, Pensacola, John C Pace, president, plans pulp and paper mill on local site, now being leased from city, to consist of several large production units for bond, book and kindred paper stocks. Power house and pumping station will be built. Cost estimated over $1,000,000. Work scheduled to begin early in 1940. James H Allen, Savannah, Ga., former vice-president of Union Bag & Paper Co, New York, N. Y., in charge of Savannah mill of company, will be an official of Florida company.

GEORGIA——Georgia Power Co, Atlanta, has plans for immediate construction of new steam-electric power plant on 22-acre tract of land fronting on Ocmulgee River, Macon, with initial installation to include 35,000-kw steam-turbine generating unit, for which award has been made to Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.; high-pressure boilers with rating of 400,000 lbs per hr, and auxiliary equipment. Boilers will be equipped to use pulverized coal, natural gas or oil as fuel. Awards for boilers and other equipment will be made soon. Plant has been designed for installation of two additional generators of same capacity noted at later date. Completion is scheduled early in 1941. Cost estimated close to $4,000,000, including power substation and transmission lines.

National Biscuit Co, 449 West 14th St, New York, N. Y., contracted George A Fuller Co, 597 Madison Ave, New York, for general erection of new branch baking plant on 32-acre tract of land on Murphey Ave, S W, Atlanta, with main unit 1-story, 400 x 1200 ft. Will include multiple traveling-ovens, air-conditioning system, automatic conveyors and other mechanical equipment. Boiler plant will be installed. Cost about $3,000,000. Completion is scheduled in July 1940. Louis Wirsching, Jr, first noted address, company architect.



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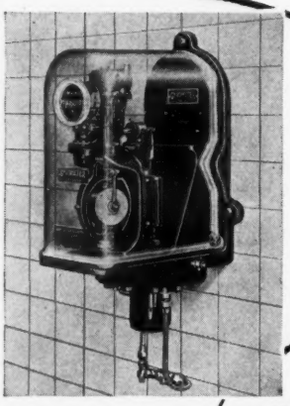

An Old Principle in a New Device

The gyroscopic force that holds Junior's little red top balanced on its point now is utilized to measure the flow of liquids in the new

•SIMPLEX• GYROMETER

The mathematical problems required for the evolution of this totalizing flow meter were many and difficult but its design is simple and its performance both accurate and positive. Through a wide range of connections the Simplex Gyrometer is adaptable to any primary device, any size main, any capacity and any fluid from water or corrosive liquids to steam and gas . . . The price? Very reasonable.

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PHILADELPHIA, PA.

ILLINOIS——Rathborne, Hair & Ridgway Co, 1440 West 21st St, Chicago, manufacturer of wooden packing boxes, plans branch plant at Charleston, S. C., for production of paper boxes and containers. Tract of 36 acres of land has been leased from city for site. Plant will consist of several 1-story units, estimated to cost about $400,000 with power equipment and machinery. A boiler house will be built.

Rock Island plans central-heating plant in new 4-story and basement municipal building. Cost about $275,000. Bids will be asked in Nov. W J Gallagher, city engineer; Cervin & Stuhr, Safety Bldg, Rock Island, architects.

The Central Illinois Public Service Co, L McGraw, president, Illinois Bldg, Springfield, has awarded general contract for a 1-story, brick and reinforced concrete power plant building to be erected at Hutsonville to the L E Myers Company, 53 West Jackson Blvd, Chicago. The equipment will include a generating unit with 25,000-kw capacity, boilers, etc. Sargent & Lundy, 14 South Dearborn St, Chicago, consulting engineers. The project will cost about $3,000,000.

Carlyle has plans maturing for improvements in municipal power plant, including new 1000-kw turbine-generator and equipment. Bids are scheduled to be asked soon.

St Clair Laundry Co, 11th street and St. Clair avenue, East St. Louis, will start construction soon on 1-story, 30-ft high, 30 by 38-ft reinforced-concrete and brick boiler plant. General contract has been awarded to Louis & Ernst, 712 North 73rd St, East St. Louis. Johnson, Maack & Saunders, 705 Olive St, St. Louis, Mo., architects.

INDIANA——Huntington plans modernization in municipal power plant, including additional equipment. Estimates of cost are being made. Lennox & Matthews, Architects' and Builders' Bldg, Indianapolis, consulting engineers.

Garrett has plans maturing for improvements in municipal power plant and waterworks station, including installation of water treatment equipment for boiler feed water, feed water regulators for 3 boilers, continuous blow-down apparatus, deareating water softener with capacity of 4000 gals. per hr, horizontal contrifugal pump for back-wash system, and miscellaneous equipment. Bevington-Williams, Inc, Indiana-Pythian Bldg, Indianapolis, consulting engineer.

Decatur, Ind., City Council is planning $500,000 modernization program of municipal light and power plant. Proposed to install 5,000-kw turbine-generator, 4,000-lb boiler, and accessory equipment.

IOWA——McGregor has plans maturing for new municipal power plant. Proposed to use diesel generators and accessories. Bond issue of $120,000 has been authorized for project. Young & Stanley, Inc, Muscatine, consulting engineer.

Ames contracted General Electric Co, Schenectady, N. Y., for 3,750-kva, turbine-generator for municipal power plant, where improvements will be made. Also made award to Elliott Co, Jeannette, Pa., for surface condenser, and to Marley Co, Kansas City, Mo., for cooling tower.

Brooklyn has authorized bond issue of $135,000 for municipal power plant and will ask bids for equipment soon. Proposed to use diesel generators and accessories.

Fort Dodge Serum Co, Fort Dodge, has approved plans for pumping station and boiler house in connection with new laboratory, total cost about $50,000.

Worthington Creamery & Produce Co, 6th and Story Sts, Rock Rapids, E O Olson, head, plans 1-story cold-storage and refrigerating plant, with locker system comprising about 800 units. Cost close to $35,000 with equipment.

Estherville will award contract soon for 1,500 to 2,000-hp diesel and auxiliary equipment for installation in municipal power plant.

KANSAS——McPherson contracted Elliott Co for 5000-kw turbine-generator and accessories; and Westinghouse Electric for municipal power plant. Awards for other equipment will be made soon. Entire project will cost about $163,000. Burns & McDonnell Engrg Co, 107 West Linwood Blvd, Kansas City, Mo., consulting.

Sterling plans complete modernization of municipal power plant, including installation of diesel engine-generating units and accessories. New building will be erected. Bond issue of $198,000 has been authorized for work. Contracts will be awarded soon. Burns & McDonnell Engrg Co, 107 West Linwood Blvd, Kansas City, Mo., consulting engineer.

The time to Stop Trouble is before it starts - - - -

It's always hazardous for nuts to work loose. The effect may mean injury to some workman or damage to your equipment. Play safe. Use

UNSHAKO

The Nuts that can't shake loose

on foundations and all moving parts of Diesels, Reciprocating Engines, Pumps, Conveyors, Generators, Stokers, etc. They "spring to life" and grasp the bolt or stud whenever there's a backing-off tendency and thereby insure permanent tightness. Of course, they can be removed with a wrench and reused if desired. Write for complete details.

Fig. 1513 Pat'd & Pat's. Pending

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. . . and NO MAINTENANCE

● What makes "Thirsty Fibre" such an old softy? Maybe the constant beating he gets. You'd think such service would be tough on paper mill equipment, but this Link-Belt herringbone gear speed reducer at the Scott Paper Co's mill, Chester, Pa., wouldn't know. It was called into service back in '25 and has been at it ever since, twenty-four hours a day, except for two stops: in 1931 the beater shaft needed realining and in 1936 old oil was cleaned out and new added. But the speed reducer wasn't touched. Its bearings and gears have required no attention.

This is another example of Link-Belt carefree service, the sort of performance industry has learned to expect from Link-Belt speed reducers. In addition to herringbone gear reducers, Link-Belt offers worm gear and motorized helical gear reducers, in a variety of sizes, ratios and horse powers. No doubt, one or more of the Link-Belt positive drives illustrated will meet your requirements.

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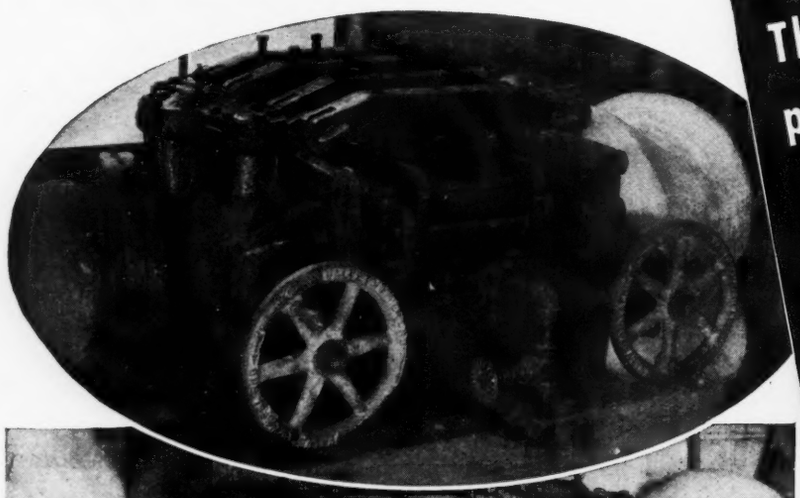
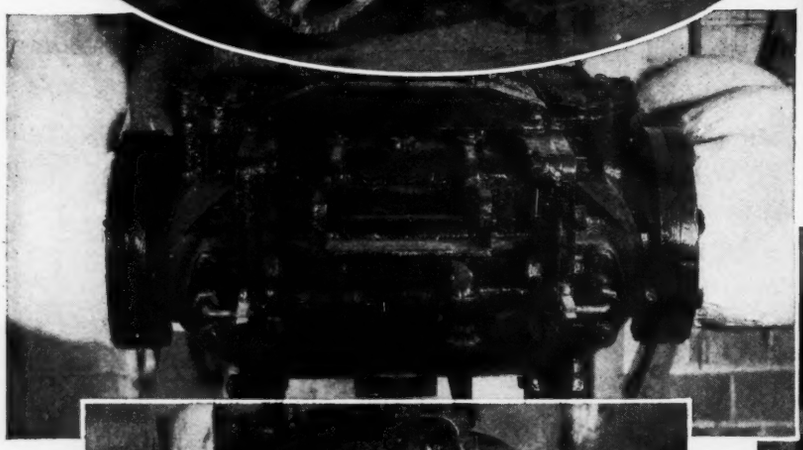
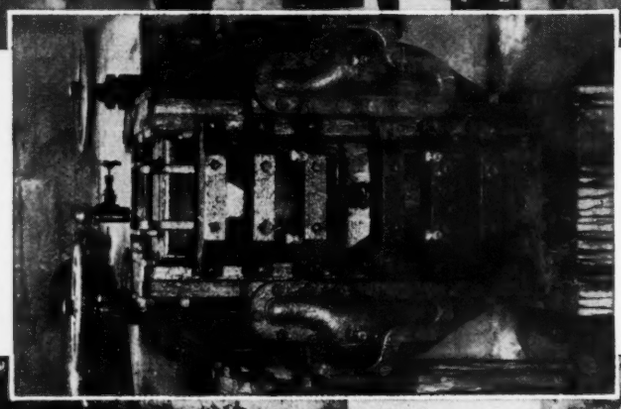
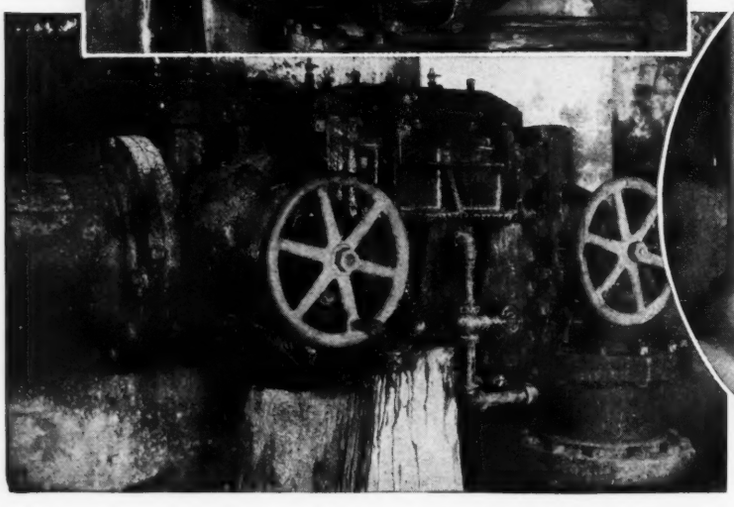
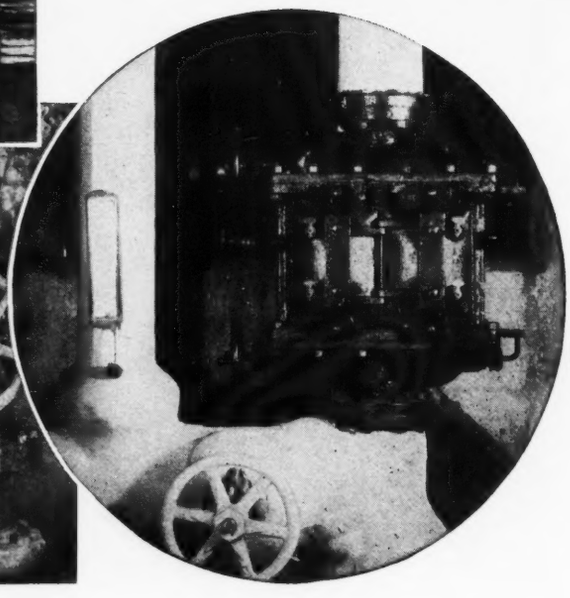






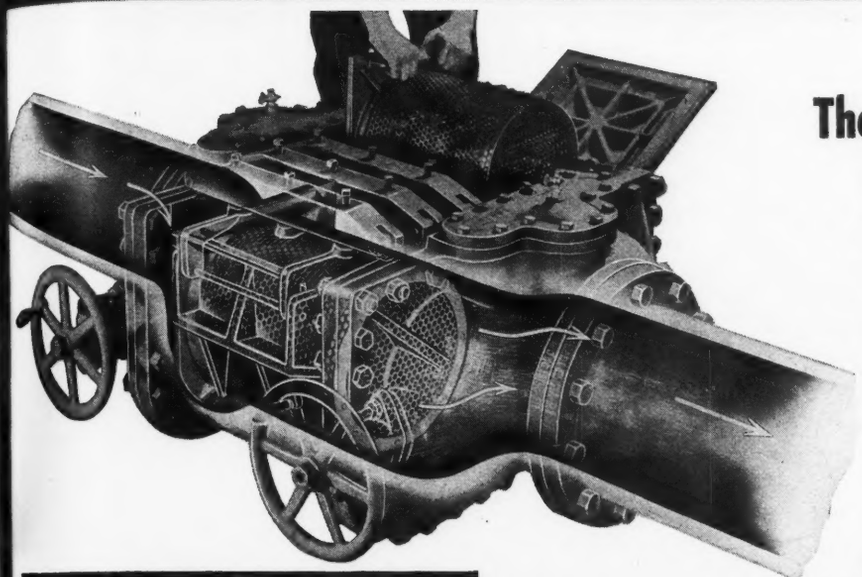




This typical case of a prominent industrial

illustrates the way very many plants assure complete freedom from foreign matter in their water or other liquids. The photos show six of the eight Twin Strainers always on the job in the Hiram Walker distillery at Peoria, Ill., protecting stills, cookers, evaporators and, in short, doing a vitally important job in maintaining the quality of the famous Hiram Walker product.

ING *problem to* ELLIOTT



The ELLIOTT TWIN STRAINER

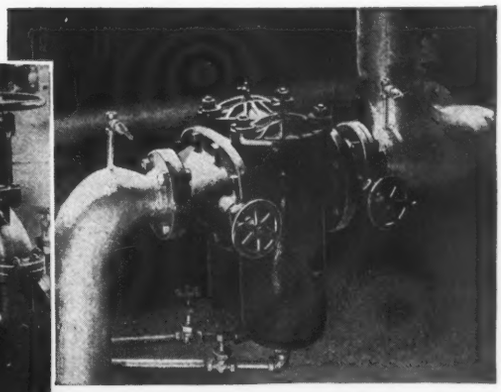
provides a service demanded in every industry where liquid is involved. It gives non-stop straining, one of the twin cylinders being always in service. Cleaning is simple and easy and can be done at any time after the flow is diverted from the fouled chamber to its twin. Often seen in whole batteries, in refineries, utilities, steel mills, paper plants, etc. Sizes from 1″ to 42″.

ELLIOTT SELF-CLEANING STRAINER

Built on a simple principle, eminently positive in operation. Requires no attention beyond ordinary maintenance. Compact and easily installed anywhere. Built in sizes from 4″ to 24″.

ELLIOTT SINGLE STRAINER

The same positive straining method as in Twin Strainers, but built with a single chamber for use where temporary shut down of the line for cleaning is permissible. Notice the gauge on the cylinder to indicate when cleaning is necessary.



ELLIOTT TWIN OIL STRAINER

adapts the twin strainer principle to oil straining. In use everywhere on fuel oil and lubricating oil lines. The best kind of protection for oil burners, pumps, etc. In sizes from 1″ to 12″.

Bring your straining problem to ELLIOTT

as so many other plants have. Elliott experience can show the logical, economical and sure way to meet your straining conditions. Fully illustrated descriptive bulletins ready for your request. Write us.

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Don't try to suit your conditions to a particular soot blower

THE great variety of boilers in use, and the wide range of services and conditions encountered, make it impossible to meet all cleaning needs with any one or two types of soot blower. • Accordingly, Diamond builds many types of blowers. Diamond engineering offers you the correct type or types for any condition. • Diamond Soot Blowers are found in every kind of boiler from the small Scotch marine in the sea-going tugs to the million-pound-per-hour giant of the Logan Station. They remove soot and slag economically and effectively.

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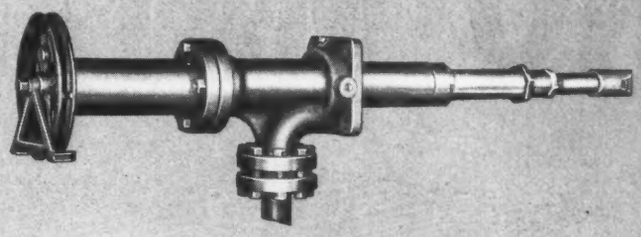
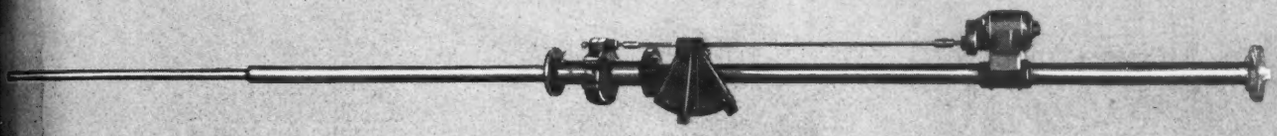
DIAMOND G9B SOOT BLOWER

Most widely used of all blowers . . . a single operation opens and closes valve and simultaneously rotates element. Among its many important features are: flexible element connection, clockwise or counter-clockwise rotation, reduced pressure blowing, external longitudinal adjustment of element, etc. See Bulletin No. 884-A.



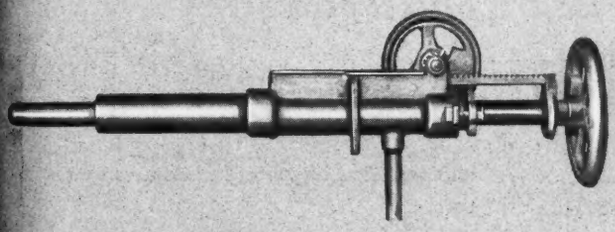
DIAMOND "CLYDE" RETRACTABLE BLOWER

Single nozzle blower automatically valved—deals effectively with slag and other deposits, especially where temperatures are extreme. The operator has only to turn the hand wheel . . . the correct blowing operations then take place automatically in proper sequence. Write for Bulletin No. 932.



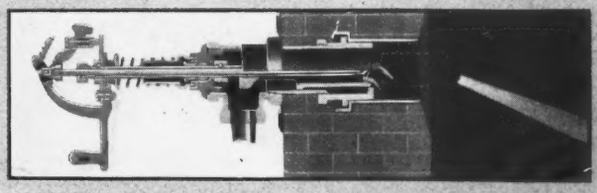
DIAMOND "TELESCOPIC" RETRACTING BLOWER

For slag removal in excessively hot locations where other Diamond Retractable Blowers have insufficient projection. This blower has a projection of 15'-8½; it is cooled by the same fluid that is used for cleaning. Motor driven . . . combines many safety features . . . such as automatic retraction should water supply fail. When retracted, element is entirely protected by housing. See Bulletin No. 906.



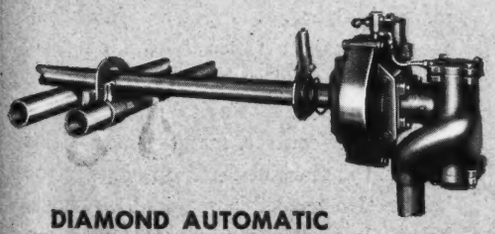
DIAMOND MODEL I RETRACTING BLOWER

A simple, effective means of cleaning water walls and radiant type superheaters. Also sometimes used to clean lower tubes of boiler proper. When in use, nozzle is projected into furnace by means of rack and pinion and is then revolved. After blowing, the nozzle is racked back into protective sleeve. Write for a copy of Bulletin No. 906.



DIAMOND MODEL B RETRACTING BLOWER

Nozzle is projected into furnace automatically by thrust of steam when valve is opened. During revolution of nozzle, it can be regulated to six positions so steam jet covers wide area. When steam is shut off, a spring automatically retracts nozzle into wall sleeve for protection against heat. Widely used on H.R.T. Boilers . . . also through roof of reheat water tube boilers. See Bulletin No. 906.

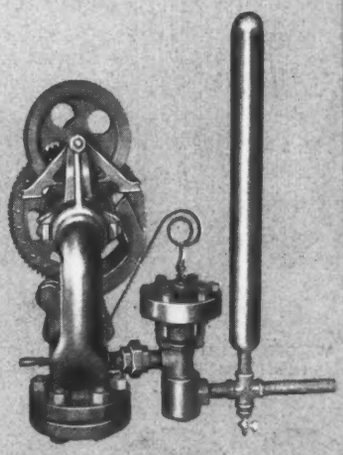


DIAMOND AUTOMATIC "AIR PUFF" SOOT BLOWER

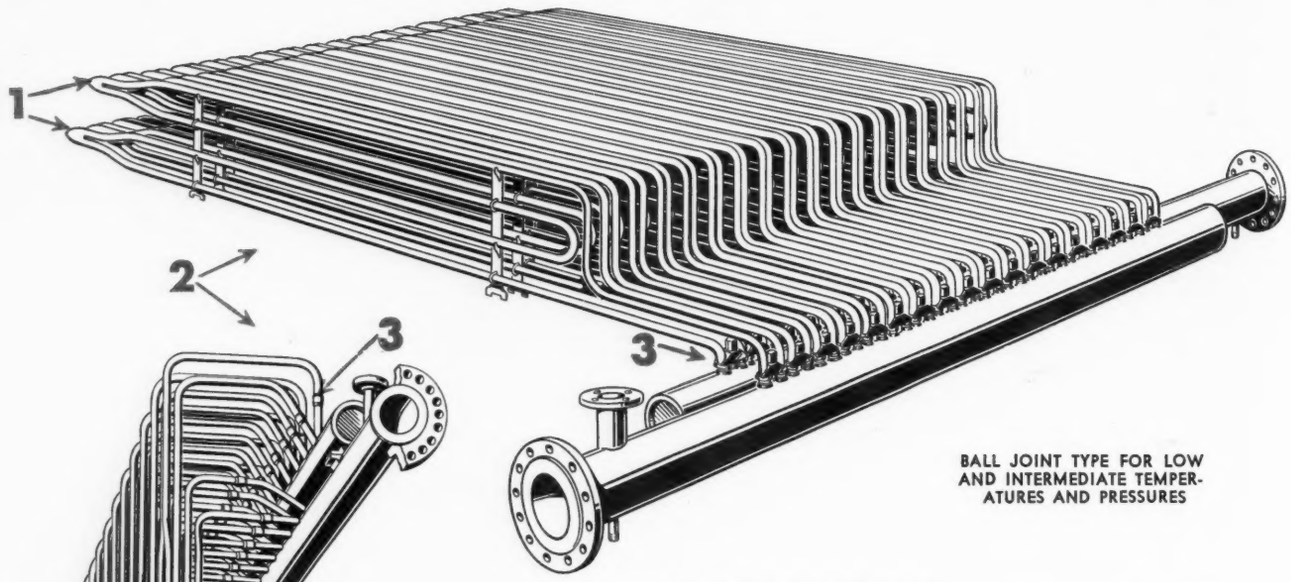
Mechanical cleaning of heating boilers (both water tube and fire tube) where operating pressure is too low to permit use of steam as cleaning medium. This air-operated blower is also useful in any type of plant where it is desired to keep makeup water to a minimum. Write for Bulletin No. 897.

DIAMOND WATER-MIX VALVE

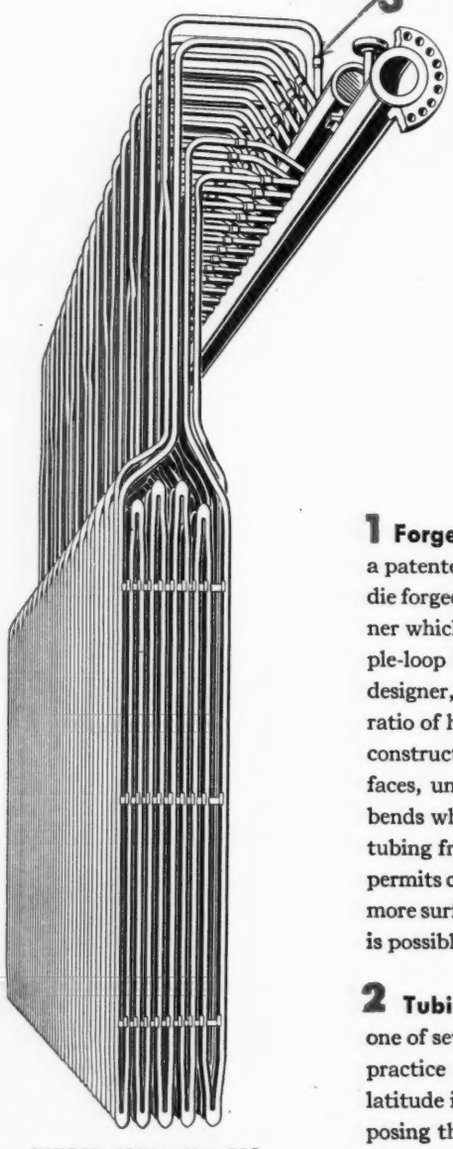
Used with standard Diamond G9B Head for deslagging boiler, superheater and water wall tubes. Blowing medium is properly controlled mixture of water and steam which is adequate except in unusual cases. Write for Bulletin No. 914.



NO MATTER WHAT



BALL JOINT TYPE FOR LOW AND INTERMEDIATE TEMPERATURES AND PRESSURES



WELDED JOINT TYPE FOR HIGH TEMPERATURES AND PRESSURES

IMPORTANT

Design and Construction

FEATURES

1 Forged Return Bends. By means of a patented process, Elesco return bends are die forged integral with the tubing in a manner which permits the fabrication of multiple-loop units of any required length. The designer, therefore, has full control over the ratio of heating surface to steam area. This construction assures smooth interior surfaces, unrestricted steam areas and return bends which are actually stronger than the tubing from which they are formed. It also permits closer spacing of tubes and therefore more surface per unit of space occupied than is possible with any other design.

2 Tubing. Elesco units are built in any one of several different sizes of tubing. This practice permits Elesco designers greater latitude in choosing tubes of a size and disposing them in a manner exactly suited to all conditions of space, location, temperature, etc.

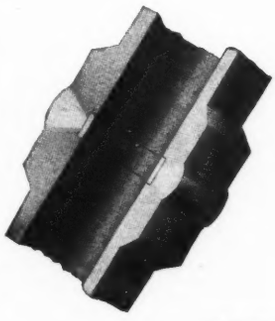
3 Joints. Two types of joints are available. For high temperatures and pressures, welded joints are used. Short sections of tubing are welded to the headers. Individual units are welded to these short sections in the field. Such joints are perfectly and permanently tight. . . . For low and intermediate pressures, the Elesco Ball Joint is used. The open ends of each unit are upset and ground to form a spherical surface which forms a line-contact, metal-to-metal joint against the machine-faced openings in the header. No gasket is required. A single, bolted clamp secures two connections in a simple, effective and convenient arrangement. . . . No hand holes are required for either type of joint.

COMBUSTION

BOILER YOU BUY—

ELESCO
INTEGRAL FORGED
RETURN BEND

ELESCO
BALL JOINT



ELESCO
WELDED JOINT

Specify ELESCO SUPERHEATERS *for these reasons*

Probably no phase of steam engineering requires the degree of "cultivated judgment" that is necessary in the determination of size, type and location of superheater equipment. Although the process of calculation itself is not particularly involved, there are usually so many variables introduced by the associated boiler and firing equipment that it is only through the application of highly specialized knowledge, and judgment developed through long experience, that a dependable conclusion can be reached.

That Elesco engineers have that kind of knowledge and judgment is apparent from such facts concerning their experience and recognition as the following:

1. Elesco Superheaters have been installed in conjunction with every established type of boiler and under virtually all firing conditions.
2. Elesco Superheaters have been selected for many of the most notable of modern steam generating units, including six of the eight units in the world having a capacity of 1,000,000 or more lb per hr. All 8 of these units have boilers utilizing double gas flow. The highest capacity, single-gas-flow boiler now in service (750,000 lb per hr) is also equipped with an Elesco Superheater. The first boiler to operate commercially with a total steam temperature of over 850 F and the first to utilize a temperature above 900 F were equipped with Elesco Superheaters.
3. Elesco Superheaters are manufactured by The Superheater Company, which has specialized in the design and manufacture of superheaters for thirty years and which is internationally recognized as the leader in this field.

The better performance of Elesco Superheaters is due not only to the highly developed skill exercised in their selection and application but also to superior design and construction features, such as those illustrated at the left and described on the opposite page.

A-434

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N. Y. • C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

CANADA: Combustion Engineering Corporation, Ltd., Montreal. SOUTH AMERICA: Mellor-Goodwin, Ltda., Paseo Colon 482, Buenos Aires, Argentina,—Caixa Postal 3525, Rio de Janeiro, Brazil. CUBA: Woodward, McMillan & Compania, Edificio Metropolitana, 739-41, Havana. PORTO RICO: Porto Rico Iron Works, Ponce.

C-E

ENGINEERING

The outstanding new E-M Magnetic Drive is simple, successful, efficient, compact, requires little more overall length than standard flange coupling.

new » Wide-Range, Stepless, Efficient Draft-Fan Control at the Turn of a Knob

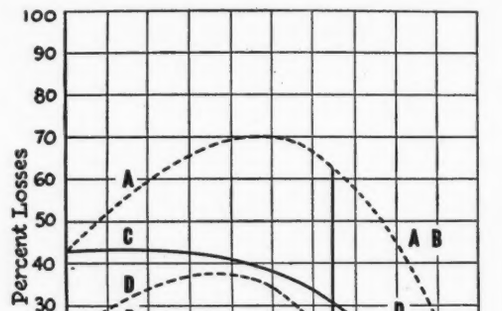
Simple: Only 2 parts, no mechanical torque connection. Finger-tip control by the simple turn of a knob. (Automatic speed control available.)

Effective: Micrometer-accurate speed control from full speed to 10% speed.

Efficient: Power loss lower than in other widely used methods of boiler fan control. Makes practical the use of synchronous motors with their high efficiency, high power factor.

Adaptable: Quickly, easily installed on new or existing fan drives, requiring little more overall length than that taken by the usual coupling it can replace.

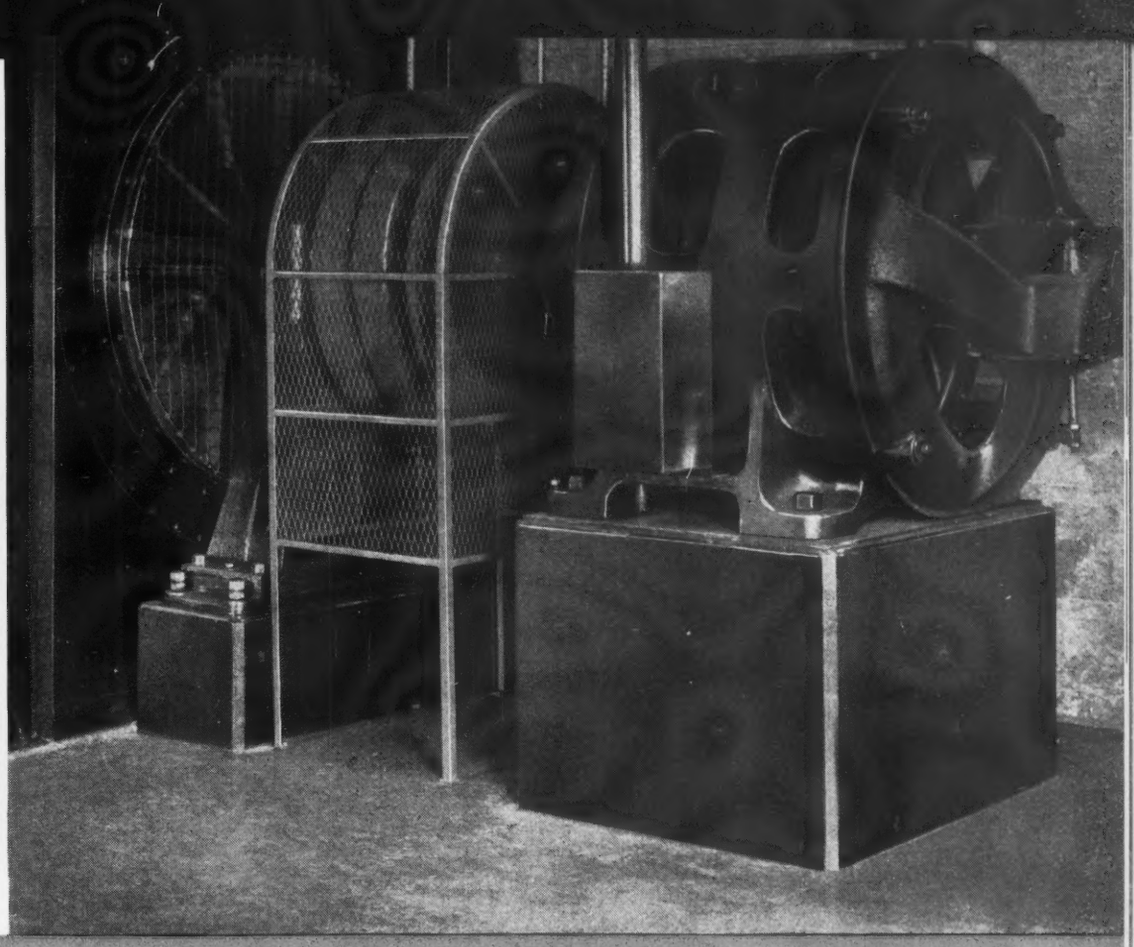
Inexpensive: First cost is attractive . . . quickly pays for itself in power savings, better boiler control and reduced maintenance. Permits use of synchronous motors.



The E-M Magnetic Drive has low average loss over the wide range of controllable speed. Curves below compare approximately the losses of various methods of output control for forced draft fan. Curves show only the losses incident to output control, by variation of drive speed or adjustment of dampers or vanes, and do not include motor losses.

A—Constant Speed Motor with Damper Control; B—Two-Speed Motor with Damper Control; C—Constant Speed Motor with Inlet Vane Control; D—Slip-Ring Induction Motor, with Damper Control between speed steps and below 65% speed; F—E-M Magnetic Drive, which varies fan output by speed control only and uses no damper or inlet vane control. (Curve F also approximates losses of so-called "hydraulic" or "fluid" drive, which however uses damper or inlet vane control, at low speeds.

Steplessly variable speed controlled throughout by a small control knob on boiler instrument panel. (Automatic speed control available.)



THE E-M MAGNETIC DRIVE

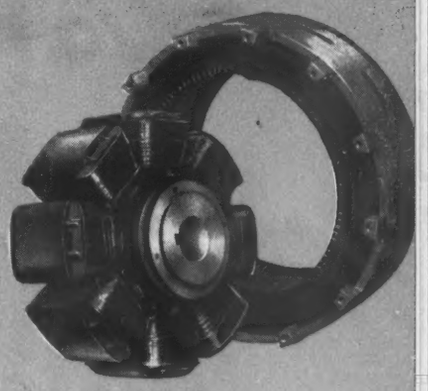
CONSTANTLY advancing methods of boiler firing have insisted on more flexible, more accurate draft control. In response to that demand, the Electric Machinery Mfg. Company now announces a simple, precise boiler draft fan speed-control device that is superior to other methods that have been afforded in the past.

The E-M Magnetic Drive is a simple, electromagnetic means of steplessly varying fan speeds from full speed down to approximately 10% speed. It consists of only two easily installed parts . . . a flux linkage ring for the motor drive shaft . . . and a magnetic flux producer for the fan shaft. The speed of the fan is controlled and varied at will by turning a control knob on the boiler instrument panel. As the flux set up by the magnetic flux producer thus varies, the speed changes accordingly. Control is positive yet torque transmission is not by mechanical contact, hence no friction, no wear.

This highly efficient and successful device is competitive with or lower in first cost than other draft fan output control devices. Averaged over the range of adjustable speed it has low losses. In affording a means of controllable speed variation the E-M Magnetic Drive opens the attractive opportunity of using *synchronous motors* with their highly efficient and controllable high power factor operation.

The E-M Magnetic Drive will pay for itself out of power savings, out of better boiler control, out of the reduction in maintenance costs.

The flexibility of control, the simplicity of installation, the low average loss of the E-M Magnetic Drive answer problems faced by power plant engineers everywhere. The attractive first cost of the E-M Magnetic Drive makes it a solution no engineer can afford to miss. Write at once for complete information giving data on your requirements. ELECTRIC MACHINERY MFG. COMPANY, 1335 Tyler Street, N.E., Minneapolis, Minnesota.



Only two parts make up the highly successful E-M Magnetic Drive . . . a magnetic flux producer and a flux linkage ring. No mechanical contact for transmission of torque. Maintenance costs are much reduced. Installation is simple.

EM MAGNETIC DRIVE

Variable Speed at the Twist of a Wrist

A Complete

YARWAY SEATLESS AND DOUBLE-TIGHTENING TANDEMS

Iron body, bronze trimmed Yarway Double-Tightening Valve and Type B Seatless Valve in Tandem. For pressures up to 200 lbs.

YARWAY SEATLESS TANDEMS

Steel body, Nitralloy trimmed Yarway Type C Seatless Tandem. **For pressures up to 600 lbs.**

YARWAY BLOW-OFF

Blow-off Valve Service

Yarway Builds Not Just One . . . But THREE DISTINCT DESIGNS OF TANDEM VALVES to Answer the Particular Blow-Down Requirements of Every Steam Plant

The product of more than a quarter-century of research and practical field experience. Each is built up to the highest standards — not down to a price.

Results of a determination to continuously lead the industry with the finest blow-down equipment that can be produced—by offering every sound mechanical and metallurgical improvement to the user — immediately, as soon as proven worthy — regardless of the manufacturing expense involved.

And because the Yarway Line is complete—you may be sure Yarway recommendations will be unbiased, based on honest judgment that the type of valve selected will give long, trouble-free, money-saving service on the job. That it will carry on the Yarway reputation for quality earned in more than 10,000 installations.

Write for Catalog No. 420 for pressures up to 400 lbs.—No. 430 for higher pressures.

YARNALL-WARING COMPANY
100 Mermaid Avenue **Philadelphia**

Forged steel body, Nitralloy and Stainless Steel trimmed Yarway Unit Tandem —a Seatless and Hard-Seat Valve combination using one common forged steel body. **For pressures up to 2500 lbs.**

F VALVES

FORGED STEEL STEAM TRAPS

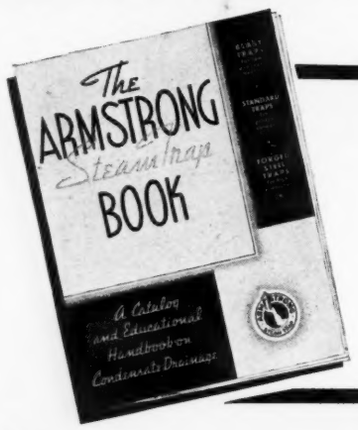
for heavy duty service!

ARMSTRONG Forged Steel Traps are built to meet the approval of engineers who want "the best," yet prices are very reasonable on a basis of capacity offered. To insure economy in application, Armstrong offers these traps in a wide range of sizes and types to accurately fit virtually any given job. In addition to standard traps with screwed or flanged connections as illustrated at the right, the line includes special traps for pulsating pressure installations and piston operated compound traps for large capacity requirements. For detailed information, see your local Armstrong Representative, or write ARMSTRONG MACHINE WORKS, 812 Maple St., Three Rivers, Michigan.

QUALITY:

(TRAPS NO. 312-515.)

Part No.	Name of Part	Material
1 & 2	Cap and Body	Die Forgings (S.A.E. 1030) 79,000 lbs. Tensile Strength
3	Bolts	Super Temp., 149,000 lbs. Tensile
4	Nuts	Hex. Semi-Finish (S.A.E. 1030)
5	Valve	Chrome Steel (Heat Treated)
6	Valve Retainer	18-8 Stainless Steel
7	Valve Lever	18-8 Stainless Steel
8	Valve Guide Plate	18-8 Stainless Steel
9	Guide Plate Screw	18-8 Stainless Steel
10	Valve Seat	Chrome Steel (Heat Treated)
11	Gasket	Compressed Asbestos Graphited or Soft Iron
12	Bucket Assembly	18-8 Stainless Steel
13	Inlet Tube	Wrought Iron
14	Bucket Weight	Cast Iron



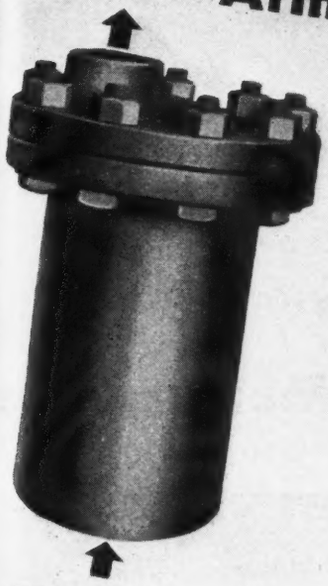
JUST OFF THE PRESS!

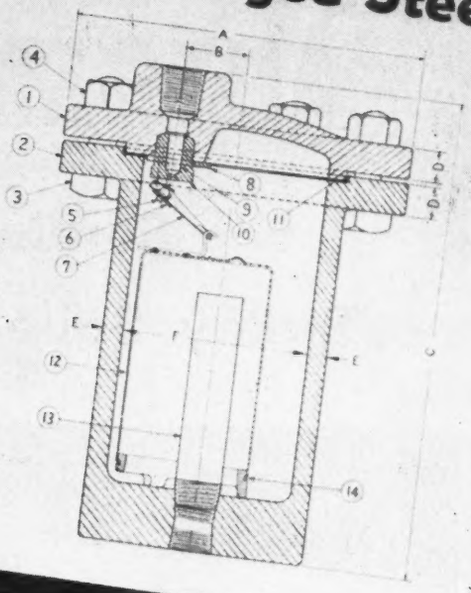
ASK your local Armstrong Representative for a copy of the new 36 page Armstrong Steam Trap Book. It contains a wealth of useful information on steam, condensate drainage, heating systems, piping, etc.

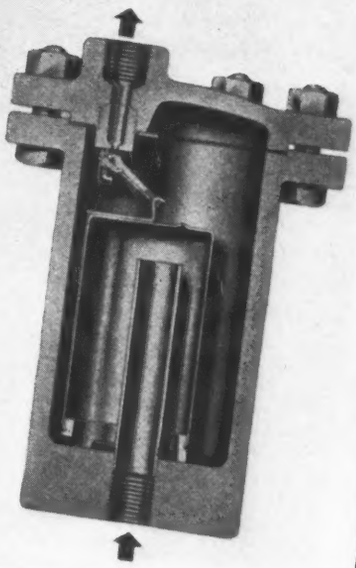
ARMSTRONG · TRADE MARK · "INVERTED BUCKET" STEAM TRAP

Helping Industry

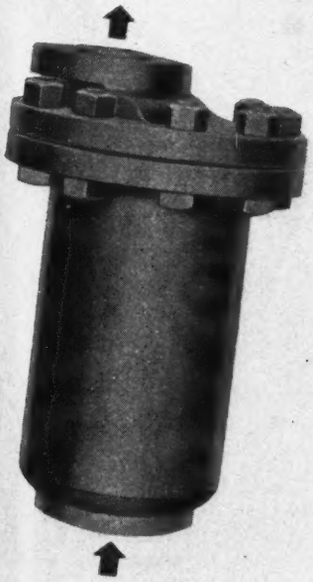
Armstrong Forged Steel Traps

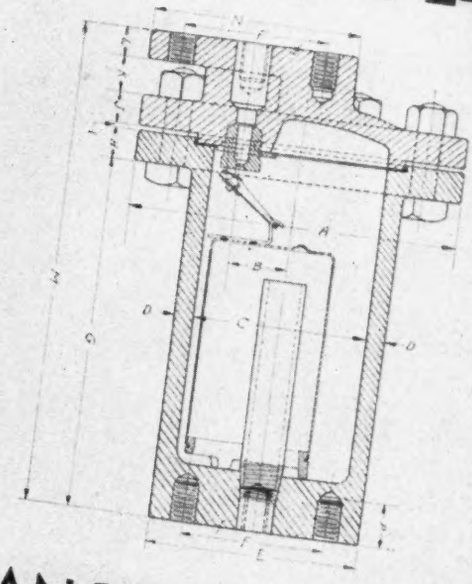


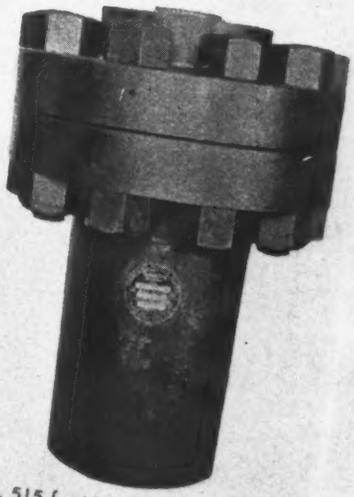




For Pressures up to 2400 lbs.







No. 515 for 1500 lbs. max. pressure

WITH FLANGED CONNECTIONS

PHYSICAL DATA AND LIST PRICES

Trap Size	No. 312F	No. 315
Pipe Connections		

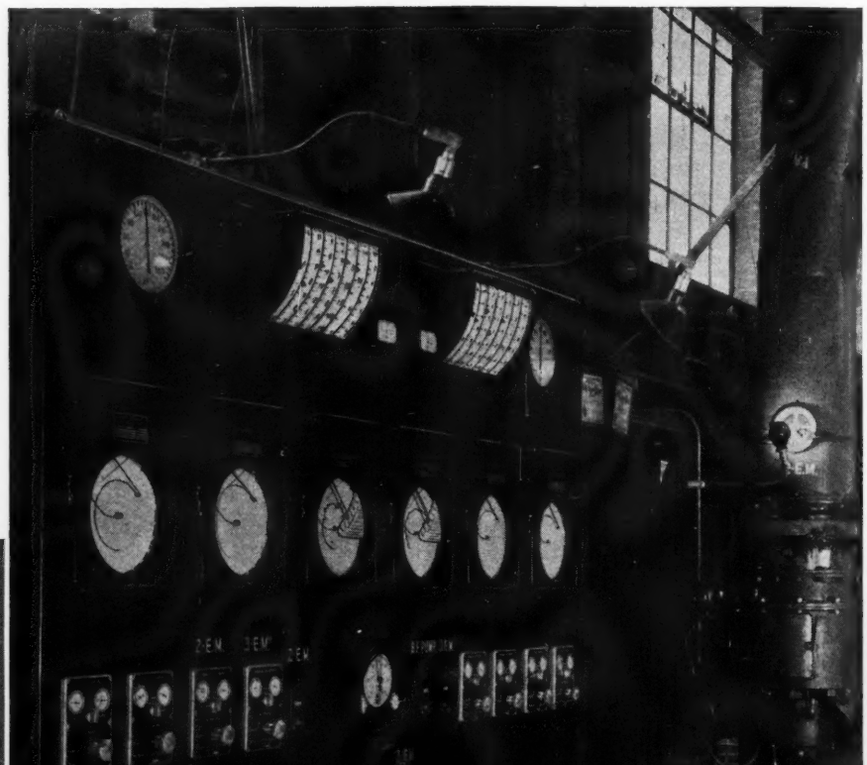
"Deliver the Goods!"

Complete Combustion

AUTOMATICALLY

Continuous Checking

Bailey Boiler Meter Raises



Bailey Boiler Control Panel for two 80,000 lb. per hour capacity pulverized coal-fired boilers. Each Bailey Boiler Meter (one for each boiler) continuously measures Steam Flow—Air Flow and by means of an air pilot valve automatically readjusts fuel—air ratio to maintain best combustion economy day after day.

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT

Control

MAINTAINS *Fuel—Air Ratio*

and Automatic Readjustment by the Monthly Efficiencies to Test Standards

● Like other good combustion control systems, Bailey Meter Control maintains steam pressure, regulates furnace draft and distributes load among boilers; but it does not stop with these usual advantages. It offers a plus value which automatically raises monthly operating efficiencies to test standards. This plus value is automatic readjustment of the fuel—air ratio.

In Bailey Meter Control, nothing is left to the uncertainty of periodic human attention. Fuel—air ratio, the factor which determines fuel economy, is continuously watched and instantly readjusted, when necessary. A sensitive air pilot valve operated by the Bailey Boiler Meter automatically compensates for variations in B.t.u. content of fuel, percentage of moisture in coal, and idiosyncrasies in feeders.

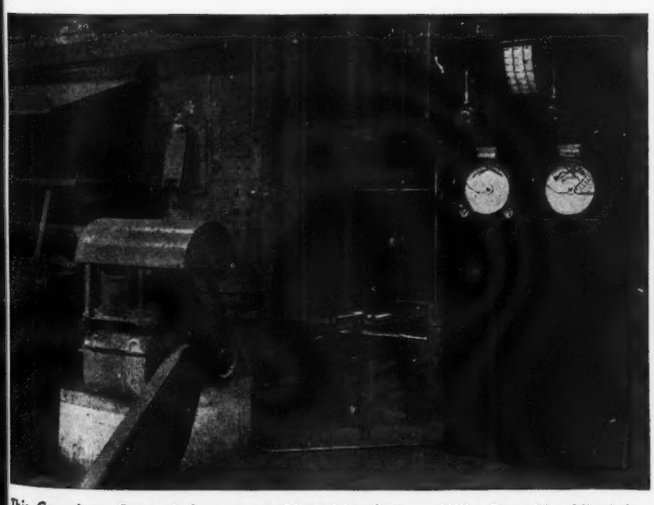
Automatic readjustment of this important ratio completes the combustion control system. It creates a control which stays on the job continuously, to insure economical combustion day after day.

According to actual operating results, fuel savings often return the entire cost of Bailey Meter Control during its first year of operation.

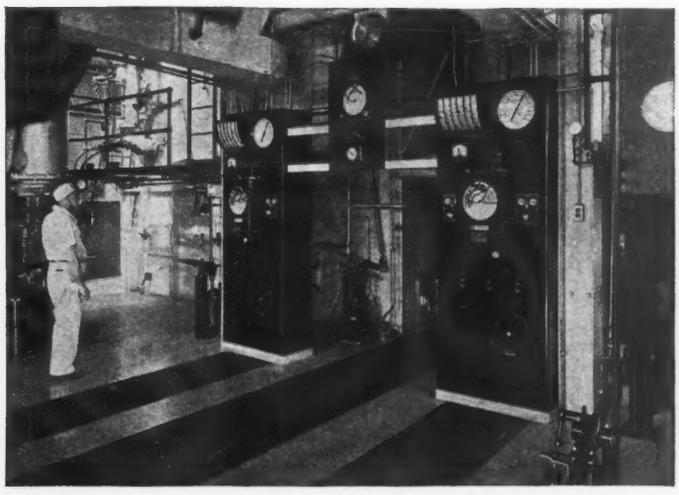
Details of this complete control system will be sent to you upon request. Ask for Bulletin 102-B. A-57

BAILEY METER COMPANY • 1036 IVANHOE ROAD • CLEVELAND, OHIO

Bailey Meter Company Limited, Montreal, Canada



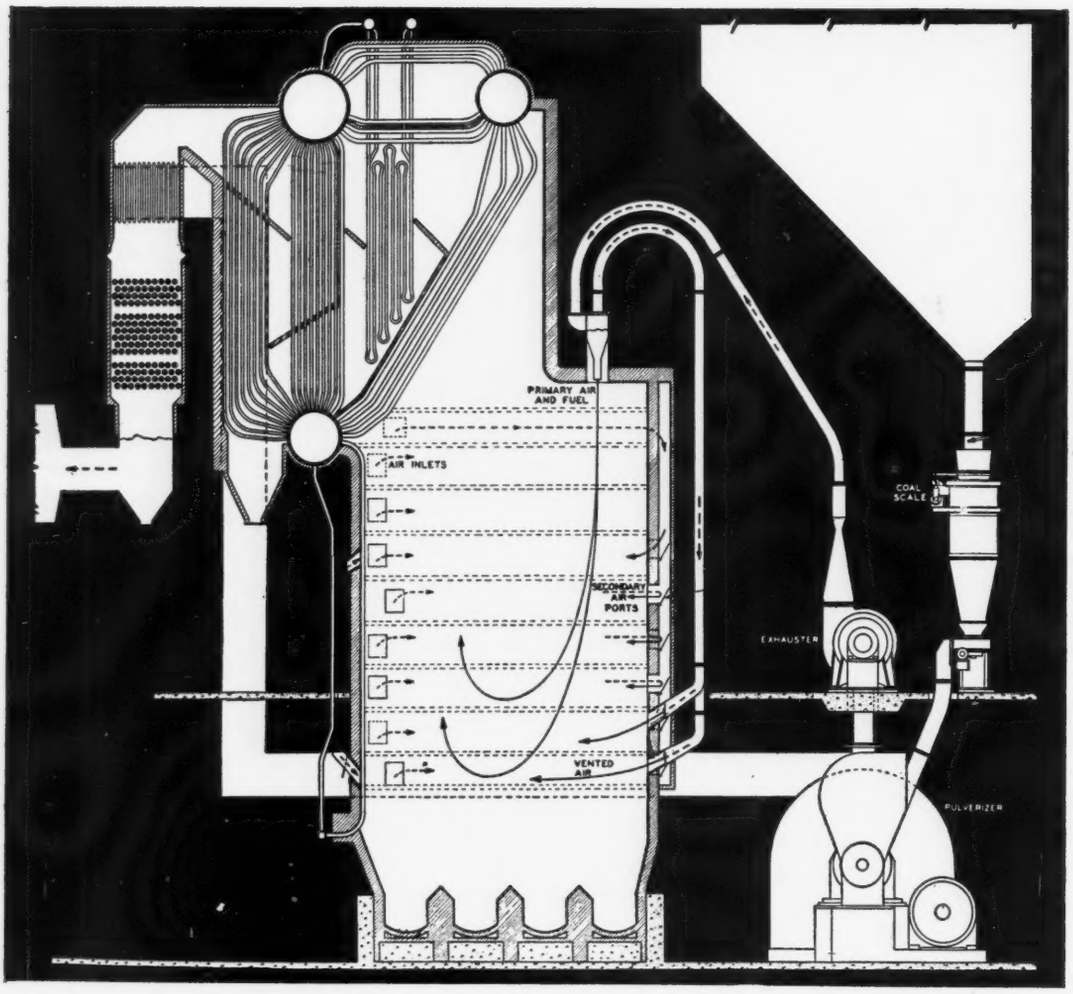
This Complete Control System at Riverside Cotton Mills, Danville, Virginia, paid for itself in three months. It allows no combustion losses to exist between visits of operators—Automatic Readjustment of Fuel—Air Ratio by the Bailey Boiler Meter insures continuous combustion economy.



This Complete Combustion Control System, at the American Molasses Co., Brooklyn, New York, returned its cost in ten months. It requires no periodic manual readjustment to maintain maximum combustion economy.

The Complete Combustion Control System

CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL



STEAM GENERATOR firing Pulverized Anthracite

Successful experience in the direct firing of pulverized waste anthracite fines was the decisive factor in the selection of this Foster Wheeler design.

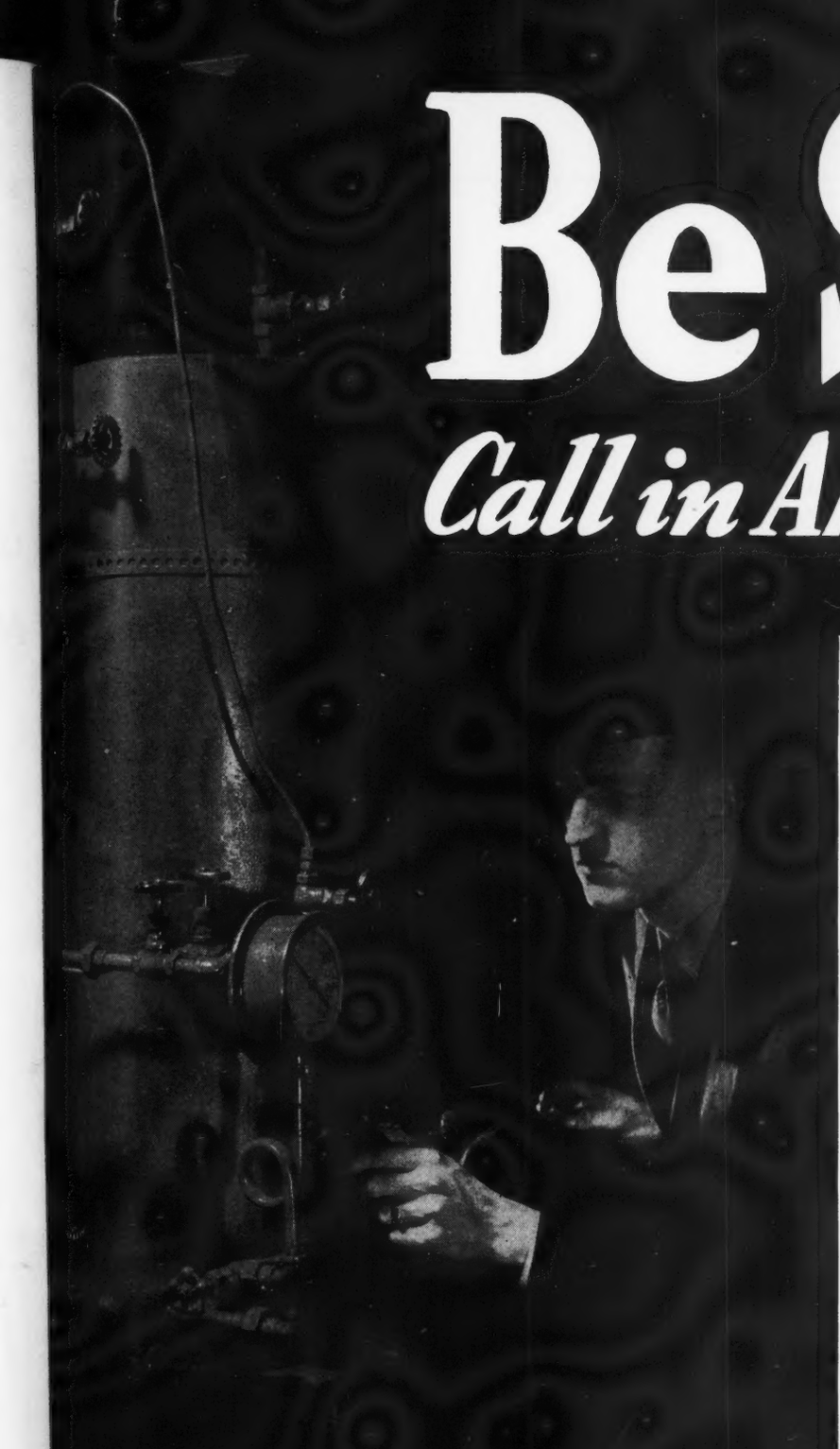
FOSTER WHEELER CORPORATION
165 BROADWAY
NEW YORK, N. Y.

The result of five years' operation has proved pulverized anthracite to be an exceedingly satisfactory and economic fuel.

FOSTER WHEELER

Be Safe

Call in Akon Service!



AN IMPORTANT DUTY OF THE AKON SERVICE Engineer is to make frequent, unsolicited calls in your plant . . . test water and steam . . . examine your feedwater equipment . . . make recommendations for the specific treatment that will provide complete protection! Like all AKON men, George H. Hoffman—shown here testing the AKON feeder — has wide experience in feedwater problems and is prepared to assume full feedwater responsibility in your plant!

90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

FEED WATER TREATING DIVISION

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

Allis-Chalmers AKON Service Engineers Give Specific Feedwater Treatment for Specific Steam Power Plant Ills . . . Provide Complete Protection at All Times Against Scale, Corrosion, Carry-Over! Be Safe—Specify AKON!

When you use a fixed boiler compound in your steam power plant, you can only trust to luck it gives you protection against corrosion . . . scale . . . carry-over!

Allis-Chalmers AKON Feedwater Service is not based on the use of a fixed boiler compound . . . nor does it depend on the element of chance. Back of AKON is Allis-Chalmers 70 years of power plant engineering . . . and this long experience has proved that specific ills require specific treatments. That's what AKON is — a treatment that reaches the specific troubles you have in your plant!

The most important feature of the AKON system is the personal cooperation of the Allis-Chalmers Service Engineer in your territory. It's his job as a salaried engineer to make feedwater recommendations . . . supervise the treatment after installation . . . assume responsibility for giving you complete protection at all times.

Don't Risk Shutdowns—Use AKON!

Any feedwater treatment which fails to take into consideration changing conditions in your water or steam trusts too much to luck . . . and fails to give you the complete protection you should have!

Don't take this risk . . . get the Allis-Chalmers AKON story! Learn the facts about this modern protection for valuable, large capacity, high-pressure plants . . . learn why leading power plant engineers are switching to AKON! Get the facts today!

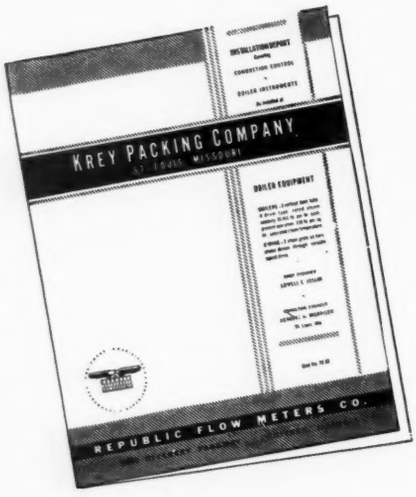
1054

REPORTS YOU WILL KEEP *because...*

THEY give complete engineering data on how steam and power costs have been cut in a number of typical industrial plants.

Each report is a case study explaining the general plant problem—how it was met—the results achieved and includes a full-page blueprint of the steam generating equipment and the automatic combustion control system.

These reports, which have been prepared expressly for power plant operating and consulting engineers, cover all sizes of boilers and types of fuel firing equipnent. Keep in touch with the latest trends in power plant practice. Write for these reports today.



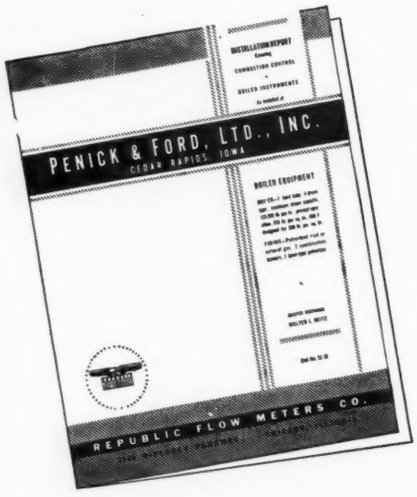
Cut Fuel Cost 50%

Krey Packing Co., St. Louis, Mo., through a power plant modernization program begun about three years ago, has been able to reduce its fuel costs to about 50 per cent of their previous amount. Further economies are expected as a result of the modernization program now being carried out in the turbine room.

BOILER EQUIPMENT

Two 35,000-lb.-per-hr., 350-lb., 700-F boilers, (present operation at 330 lb., sat.); fired by chain-grate stokers.

Write for Installation Report No. 70-39.



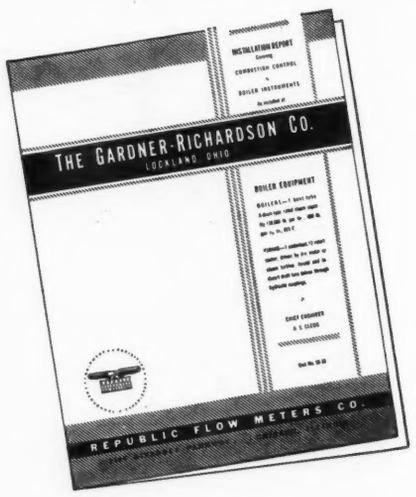
Economy Important Here

Power plant economy is important to Penick & Ford, Ltd., Inc., because the cost of steam, water and power constitutes about 25% of the total processing cost. The new steam generating unit increases steam supply from existing power plant by 125,000 lb. per hour. This boiler is under complete automatic control.

BOILER EQUIPMENT

One 125,000-lb.-per-hr., 500-lb., 600-F boiler fired with pulverized coal or natural gas.

Write for Installation Report No. 52-39.



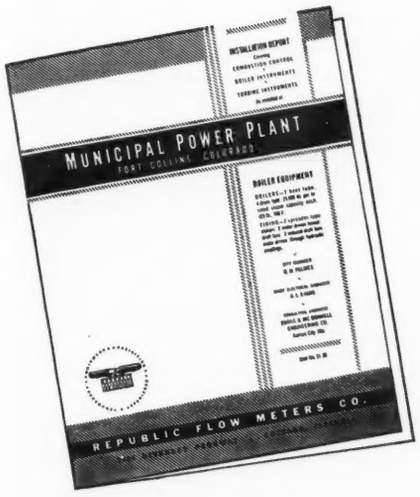
Increase Efficiency 14%

As a result of a program of power plant improvement begun some time ago and carried out in two steps, the Gardner-Richardson Co. of Lockland, Ohio, have increased their steam generating efficiency 14 per cent, improved their steam-electric balance and reduced the amount of steam required to operate the mill.

BOILER EQUIPMENT

One 130,000-lb.-per-hr., 400-lb., 625-F boiler fired by a 12-retort underfeed stoker; forced and induced draft fans driven through hydraulic couplings.

Write for Installation Report No. 50-39.



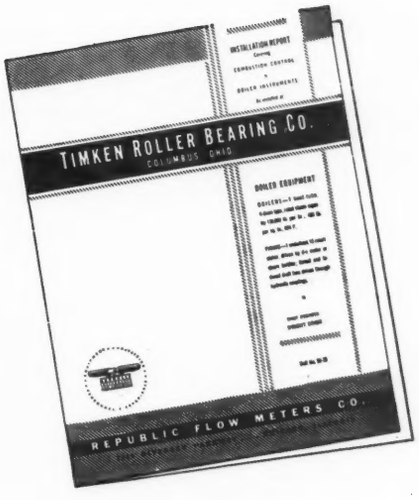
Exceed Guarantee by 3%

The new municipal power plant of the City of Fort Collins, Colorado was built with the idea that it would make a profit for the city sufficient to pay off the municipal debt. The boilers, under automatic combustion control and fired with 9350 B.t.u. Colorado coal, are operating at an average overall efficiency of 77½ per cent as compared with the guaranteed test efficiencyof 74½ per cent. Control of both boiler and turbine operations is centralized at one point.

BOILER EQUIPMENT

Two 25,000-lb.-per-hr., 425-lb., 700-F boilers fired by spreader type stokers. Induced draft fans motor-driven through hydraulic couplings.

Write for Installation Report No. 51-39.



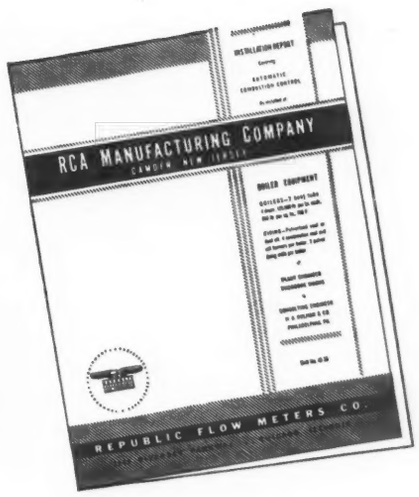
Triple Power Output

The topping units recently installed in the power plant of Timken Roller Bearing Co., Columbus, Ohio, enable the entire plant to produce 2250 kw. with the same amount of fuel formerly used to produce 750 kw. The high pressure boiler generates steam at 87 per cent boiler efficiency under complete automatic control. Topping units were installed without interfering with production and have demonstrated high economy, reliability and flexibility in everyday operation.

BOILER EQUIPMENT

One 60,000-lb.-per-hr., 400-lb., 650-F boiler, fired by a 7-retort, turbine-driven, underfeed stoker.

Write for Installation Report No. 60-39.



Save $125,000 Per Year

About a year ago the RCA Manufacturing Co. installed a topping plant at their Camden, N. J. factory. As a result, the steam generating efficiency of this power plant has been increased from 64 per cent to 82 per cent. Including all interest charges, it is calculated that this topping unit will pay for itself in about 6 years. The anticipated reduction in the annual fuel bill alone is $125,000 to $135,000. Further economies are expected due to reduction of maintenance and repair costs.

BOILER EQUIPMENT

Two 125,000-lb.-per-hr., 850-lb., 750-F boilers fired with pulverized coal or fuel oil.

Write for Installation Report No. 43-39.

This series of installation reports covering all types of modern industrial power plants will be mailed to any operating or consulting engineer upon request. Write for your copies today.

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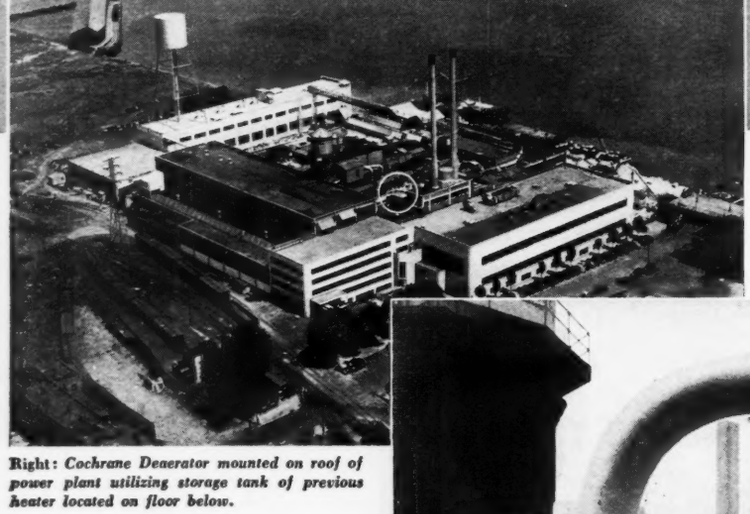
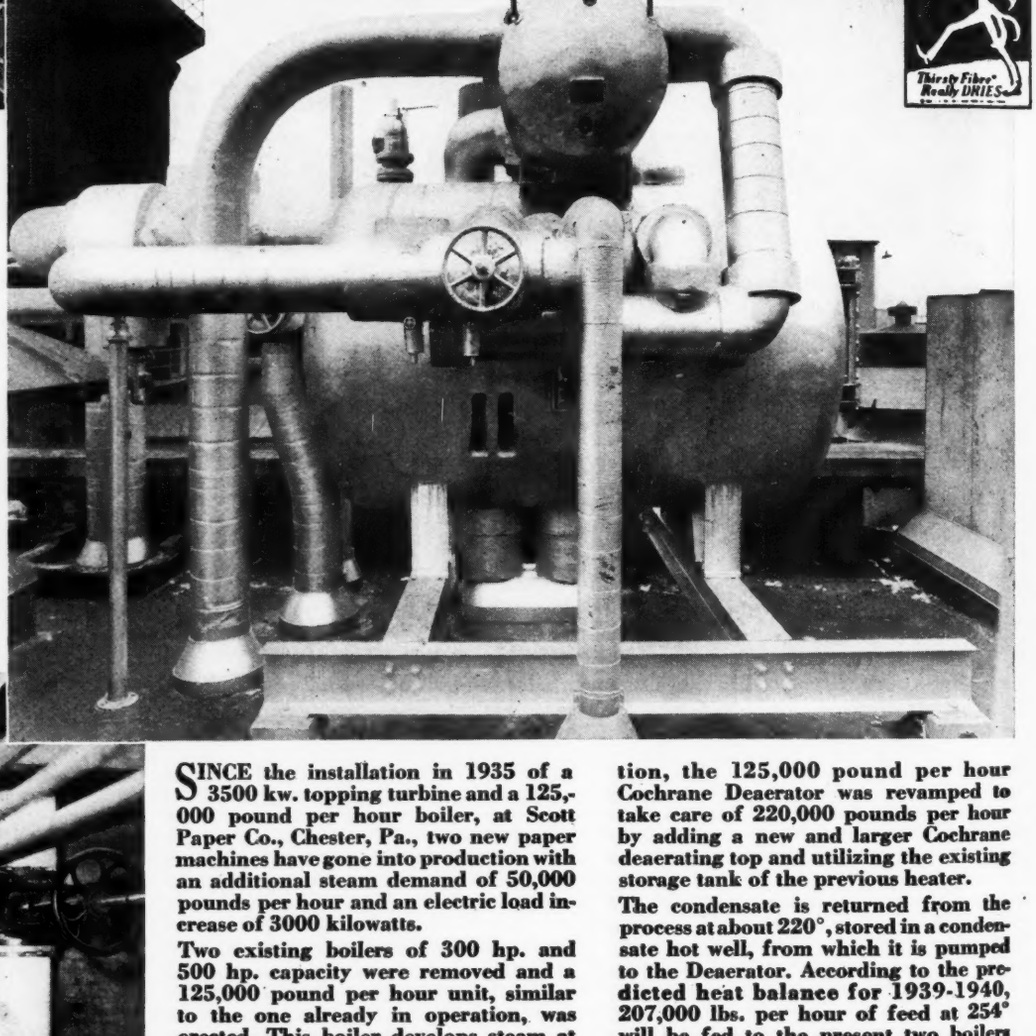


Air view of the Scott Paper Company at Chester, Pa. Circle shows the location of the new Cochrane Deaerator on the roof of the building.



Right: *Cochrane Deaerator mounted on roof of power plant utilizing storage tank of previous heater located on floor below.*

Left: *Deaerator is of the metering type. View shows the Cochrane V-Notch Recorder mounted at the outlet of the old storage tank above boilers and breeching.*

Below: *Cochrane Multiport Valves protect Deaerator and turbine bleed lines at Scott Paper Company.*

SINCE the installation in 1935 of a 3500 kw. topping turbine and a 125,000 pound per hour boiler, at Scott Paper Co., Chester, Pa., two new paper machines have gone into production with an additional steam demand of 50,000 pounds per hour and an electric load increase of 3000 kilowatts.

Two existing boilers of 300 hp. and 500 hp. capacity were removed and a 125,000 pound per hour unit, similar to the one already in operation, was erected. This boiler develops steam at 630 pounds per square inch pressure and 750° total temperature. In addition, the 125,000 pound per hour Cochrane Deaerator was revamped to take care of 220,000 pounds per hour by adding a new and larger Cochrane deaerating top and utilizing the existing storage tank of the previous heater.

The condensate is returned from the process at about 220°, stored in a condensate hot well, from which it is pumped to the Deaerator. According to the predicted heat balance for 1939-1940, 207,000 lbs. per hour of feed at 254° will be fed to the present two boilers from the storage tank of the deaerating heater.

COCHRANE CORPORATION • 3106 N. 17

COCHRANE

DEAERATORS • HOT PROCESS SOFTENERS • DEAERATING SOFTENERS FILTE

r uses another
hrane Deaerator .

What the Pulp and Paper Industry Thinks of Cochrane Deaerators

The following plants testify to the satisfactory operation of Cochrane Deaerators and Deaerating Hot Process Softeners in the pulp and paper industry. Many, it will be noted, are repeat orders.

PARTIAL LIST OF COCHRANE DEAERATORS IN PULP AND PAPER MILLS

Albemarle Paper Mfg. Co.	Richmond, Va.	80,000#/hr	1937
Allied Paper Mills	Kalamazoo, Mich.	60,000#/hr	1936
Alton Box Board & Paper Co.	Alton, Ill.	270,000#/hr	1931
Anglo-Canadian Pulp & Paper Mills	Quebec, Can.	280,000#/hr	1927
Anglo-Newfoundland Develop. Co.	Grand Falls, Newfoundland	90,000#/hr	1927
Bathurst Power & Paper Co.	New Brunswick, N. S.	300,000#/hr	1937
Bergstrom Paper Co.	Neenah, Wis.	130,000#/hr	1928
Brightwater Paper Co.	Adams, Mass.	35,000#/hr	1939
Canadian Internat'l Paper Co.	Gatineau, Quebec	450,000#/hr	1932
Carthage Mills	Carthage, N. Y.	32,000#/hr	1929
Champion International Co.	Lawrence, Mass.	150,000#/hr	1931
Champion Paper & Fibre Co.	Houston, Texas	225,000#/hr	1936
Chesapeake Corp.	West Point, Va.	461,000#/hr	1935
Container Corp. of America	Philadelphia, Pa.	100,000#/hr	1934
Crocker, Burbank Ass'n.	Fitchburg, Mass.	140,000#/hr	1927
Crown Williamette Paper Co.	Camas, Wash.	250,000#/hr	1929
Dexter & Sons, Inc., C. H.	Windsor Locks, Conn.	40,000#/hr	1929
Eastern Manufacturing Co.	Bangor, Me.	90,000#/hr	1931
Ecusta Paper Corp.	Brevard, N. C.	70,000#/hr	1938
Fernandina Pulp & Paper Co.	Fernandina, Fla.	400,000#/hr	1937
Fitchburg Paper Co.	Fitchburg, Mass.	170,000#/hr	1928
Fitchburg Paper Co.	Fitchburg, Mass.	140,000#/hr	1931
Forrester Nace Co.	Kansas City, Mo.	27,000#/hr	1927
Fort William Paper Co.	Fort William, Ont.	300,000#/hr	1926
Fraser Paper Co.	Madawaska, Me.	120,000#/hr	1925
Fraser Paper Co.	Madawaska, Me.	250,000#/hr	1928
Gair, Inc., Robert	Cleveland, Ohio	30,000#/hr	1938
George Co., S.	Wellsburg, W. Va.	12,000#/hr	1938
Glatfelter, P. H.	Spring Grove, Pa.	156,000#/hr	1930
Grays Harbor Pulp & Paper Co.	Hoquiam, Wash.	200,000#/hr	1927
Gulf States Paper Corp.	Holt, Ala.	400,000#/hr	1928
Gulf States Paper Corp.	Holt, Ala.	150,000#/hr	1928
Halifax Paper Co.	Roanoke Rapids, N. C.	80,000#/hr	1937
Hamilton & Son, W. C.	Miquon, Pa.	60,000#/hr	1934
Harriman Paperboard Corp.	Harriman, Tenn.	100,000#/hr	1928
Harrisville Paper Co.	Harrisville, N. Y.	75,000#/hr	1928
Heald Co., John H.	Lynchburg, Va.	250,000#/hr	1928
Hennepin Paper Co.	Minneapolis, Minn.	50,000#/hr	1931
Hollingsworth & Whitney Co.	Waterville, Me.	300,000#/hr	1930
Inland Container Corp.	Indianapolis, Ind.	18,000#/hr	1935
International Paper Co.	Ticonderoga, N. Y.	75,000#/hr	1937
Kieckhefer Container Co.	Delair, N. J.	225,000#/hr	1925
Kimberly Clark Co.	Neenah, Wis.	105,000#/hr	1928
Kraft Company of America	Fernandina, Fla.	150,000#/hr	1937
Lang Mills	Gloucester, N. J.	150,000#/hr	1930
Maine Seaboard Paper Co.	Augusta, Me.	130,000#/hr	1930
Manchester Board & Paper Co.	Roanoke Rapids, N. C.	23,000#/hr	1937
Manchester Board & Paper Co.	Richmond, Va.	30,000#/hr	1937
Marine Seaboard Paper Co.	Augusta, Me.	175,000#/hr	1939
Mead Pulp and Paper Co.	Chillicothe, Ohio	300,000#/hr	1925
Mead Pulp and Paper Co.	Chillicothe, Ohio	200,000#/hr	1929
Mersey Paper Co.	Liverpool, N. S.	130,000#/hr	1929
Minnesota & Ontario Paper Co.	Kenora, Ont.	300,000#/hr	1925
Minnesota & Ontario Paper Co.	International Falls, Minn.	415,000#/hr	1927
Munising Paper Co.	Munising, Mich.	250,000#/hr	1929
Nashua River Paper Co.	E. Pepperell, Mass.	45,000#/hr	1925
Natick Box & Board Co.	Natick, Mass.	40,000#/hr	1930
National Folding Box Co.	New Haven, Conn.	150,000#/hr	1938
National Paper Products Co.	Stockton, Cal.	170,000#/hr	1926
National Paper Products Co.	Port Townsend, Wash.	250,000#/hr	1927
National Paper Products Co.	Carthage, N. Y.	45,000#/hr	1928
New Haven Pulp & Board Co.	New Haven, Conn.	75,000#/hr	1928
New Haven Pulp & Board Co.	New Haven, Conn.	172,000#/hr	1937
Northwest Paper Co.	Cloquet, Minn.	360,000#/hr	1928
Olympic Forest Products Co.	Port Angeles, Wash.	250,000#/hr	1929
Ontario Paper Co. Ltd.	Comeau Bay, Quebec	220,000#/hr	1937
Pacific Mills, Ltd.	Ocean Falls, B. C.	250,000#/hr	1929
Pacific Mills, Ltd.	Columbia, S. C.	36,000#/hr	1935
Pacific Mills, Ltd.	Ocean Falls, B. C.	80,000#/hr	1938
Penobscot Chemical Paper Co.	Great Works, Me.	175,000#/hr	1938
Puget Sound Pulp & Timber Co.	Everett, Wash.	150,000#/hr	1930
Puget Sound Pulp & Timber Co.	Bellingham, Wash.	80,000#/hr	1937
Ranier Pulp & Paper Co.	Shelton, Wash.	54,675#/hr	1934
Restigouche Co. Ltd.	Campbellton, N. B.	190,000#/hr	1932
Rhinelander Paper Co.	Rhinelander, Wis.	150,000#/hr	1929
Riegel Paper Corp.	Milford, N. J.	95,000#/hr	1930
Riegel Paper Corp.	Riegelsville, Pa.	50,000#/hr	1935
Riegel Paper Corp.	Milford, N. J.	150,000#/hr	1939
Robertson Paper Box Co.	Montville, Conn.	20,000#/hr	1937
St. Anne Paper Co.	Beaupre, P. Q.	180,000#/hr	1927
St. Croix Paper Co.	Woodland, Me.	35,000#/hr	1925
St. Croix Paper Co.	Woodland, Me.	180,000#/hr	1930
St. Joe Paper Co.	St. Joe, Fla.	300,000#/hr	1937
St. Regis Paper Co.	Norfolk, N. Y.	65,000#/hr	1928
Scott Paper Co.	Chester, Pa.	125,000#/hr	1933
Scott Paper Co.	Chester, Pa.	220,000#/hr	1938
Shaffer Pulp Co.	Tacoma, Wash.	100,000#/hr	1936
Sonoco Products Co.	Hartsville, S. C.	100,000#/hr	1936
Sorg Paper Co., Paul A.	Middletown, Ohio	150,000#/hr	1926
Spruce Falls Power & Paper Co.	Kapuskasing, Ont.	360,000#/hr	1927
Spruce Falls Power & Paper Co.	Kapuskasing, Ont.	120,000#/hr	1930
Standard Paper Co.	Richmond, Va.	45,000#/hr	1929
Sweitzer, Peter J.	Waverly, N. Y.	28,000#/hr	1931
Tonawanda Paper Co.	Tonawanda, N. Y.	125,000#/hr	1924
Union Bag & Paper Co.	Tacoma, Wash.	250,000#/hr	1928
U. S. Playing Card Co.	Cincinnati, Ohio	108,000#/hr	1931
Vancouver Kraft Co.	Port Mellon, B. C.	70,000#/hr	1936
Waldorf Paper Co.	St. Paul, Minn.	230,000#/hr	1928
Weyerhauser Timber Co.	Everett, Wash.	220,000#/hr	1931
Weyerhauser Timber Co.	Longview, Wash.	415,000#/hr	1931
Weyerhauser Timber Co.	Everett, Wash.	150,000#/hr	1935
Wheelwright Paper Co.	N. Leominster, Mass.	35,000#/hr	1925

DEAERATING HOT PROCESS SOFTENERS*

Container Corporation of America	Chicago, Ill.	12,000/12,000 GPH	1933
Dresden Paper Mills	Dresden, Ohio	3,200/3,200 GPH	1935
Fox Paper Co.	Lockland, Ohio	2,400/3,600 GPH	1933
Hammermill Paper Co.	Erie, Pa.	21,000/21,000 GPH	1936
Morris Paper Mills	Morris, Ill.	3,200/12,000 GPH	1936
Ontario Paper Company	Thorold, Canada	10,000/20,000 GPH	1936

*First figure of capacity indicates raw water capacity in gallons per hour; second figure indicates condensate capacity in gallons per hour. Total capacity of softener is not always sum of both figures.

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One of the most important ingredients in Gargoyle D.T.E.'s is the experience that goes into their manufacture.

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Successful operation of every machine depends on the quality of the oil that forms the *microscopic coating* which helps prevent metal-to-metal contact.

THE SOCONY-VACUUM man offers you a complete line of lubricants, plus these *exclusives:*

The right lubricant for every machine . . . and new lubricants ahead of new needs . . . developed by world-famous research laboratories through close cooperation with machine builders.

73 years' experience—thousands of case histories—to guide in prescribing the right use of these lubricants to gain Lubrication Profits for you.

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How De Laval beats HEAT, CORROSION and STRESS...

Turbo-driven 2 stage centrifugal boiler feed pump built by De Laval Steam Turbine Co., Trenton, N. J. "K" Monel shaft offers great strength, corrosion resistance, high modulus of elasticity, low heat transfer and moderate coefficient of expansion for maintenance of longitudinal adjustment. "K" Monel sleeves offer great hardness and resistance to abrasion by packing. Cast Monel impellers are chosen for rust proof resistance to erosion by high velocity water, which is rapidly destructive to bronze.

Two members of the Nickel-copper alloy family make a perfect team for a job like this turbo-driven feed pump

Typical of jobs that call for *more than ordinary care in the selection of metals* is the power plant application shown above. It is also typical of how you can *team up* the Nickel-copper alloys to do an unusual job under severe conditions of service.

This De Laval turbo-driven two-stage centrifugal boiler feed unit pumps 240° F. water at 5000 r.p.m. Right there you see the need of an impeller metal that will not only withstand the corrosive and erosive attack of boiling water, but which also has *strength* enough for the load, and sufficient *hardness* to avoid cavitation.

Now take a look at the shaft. Note how it carries both turbine rotor and pump impeller. Here you need the strength and hardness of the alloy steels... *plus* freedom from rust and high resistance to abrasion by gland packing.

The metals for both of these major parts are found among the Nickel-copper alloys. For the impeller . . . cast Monel. For shaft and wearing sleeves... forged, high tensile, heat-treated "K" Monel. Incidentally, for holding in place the carbon block packing rings in the gland section of the turbine rotor, garter springs of Inconel*, a Nickel-chromium alloy, are used. This alloy offers excellent spring properties up to 750° F., and does not rust.

When you need a strong, tough metal that must also be rust proof, use one of these high-Nickel alloys. INCO engineers will gladly help you select the one offering the chemical and physical properties you need. Write for further information. Address:

MONEL*...two-thirds Nickel and one-third copper, combines resistance to corrosion with strength and toughness. Available in all mill forms. Tensile strength 70-115,000 p.s.i. Hardness 120-200 Brinell.

"K" MONEL*...a new heat-treatable Nickel-copper alloy for applications requiring extreme strength and hardness. Easily fabricated prior to heat treatment. Available as bars, rods, forgings and as strip. Tensile strength 110-165,000 p.s.i. Hardness 150-325 Brinell.

"S" MONEL*...a cast Nickel-copper alloy rendered extra hard and heat-treatable through the addition of silicon. Offers valuable non-galling characteristic, and will not seize when used with Monel. Tensile strength 90-115,000 p.s.i., Hardness 280-350 Brinell.

• • •

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET NEW YORK, N. Y.

*"Monel" and other trade-marks which have an asterisk associated with them are trade-marks of The International Nickel Company, Inc.

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Chemically... Physically ...Dimensionally

Grinnell Welding Fittings are identical in every characteristic with seamless pipe – a sure guarantee that the joints in your piping system will be easy to make. And will *remain trouble-free* over long years of service under every condition of operation.

With these Fittings, every weld is a plain circumferential butt weld, the simplest and strongest of all. Welding faces are properly beveled. Any qualified welder can give you joints stronger than the pipe itself, with no slag or ragged corners to obstruct free flow.

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WHENEVER PIPING IS INVOLVED

A NEW TWIST IN BRAIDED PACKING . . .

J-M INTERLOCKED Braided Packing is the most recent development of the J-M Packing Laboratory. Note how the strands of yarn are tightly interlocked to form a solid, square braid that cannot ravel or come apart.

INTERLOCKED

The greatest single improvement ever made in braided packings—J-M Interlocked, developed in the J-M Packing Laboratory, assures longer life, lower maintenance, increased efficiency in high-speed, heavy-duty service.

Above
SQUARE-PLAITED BRAID

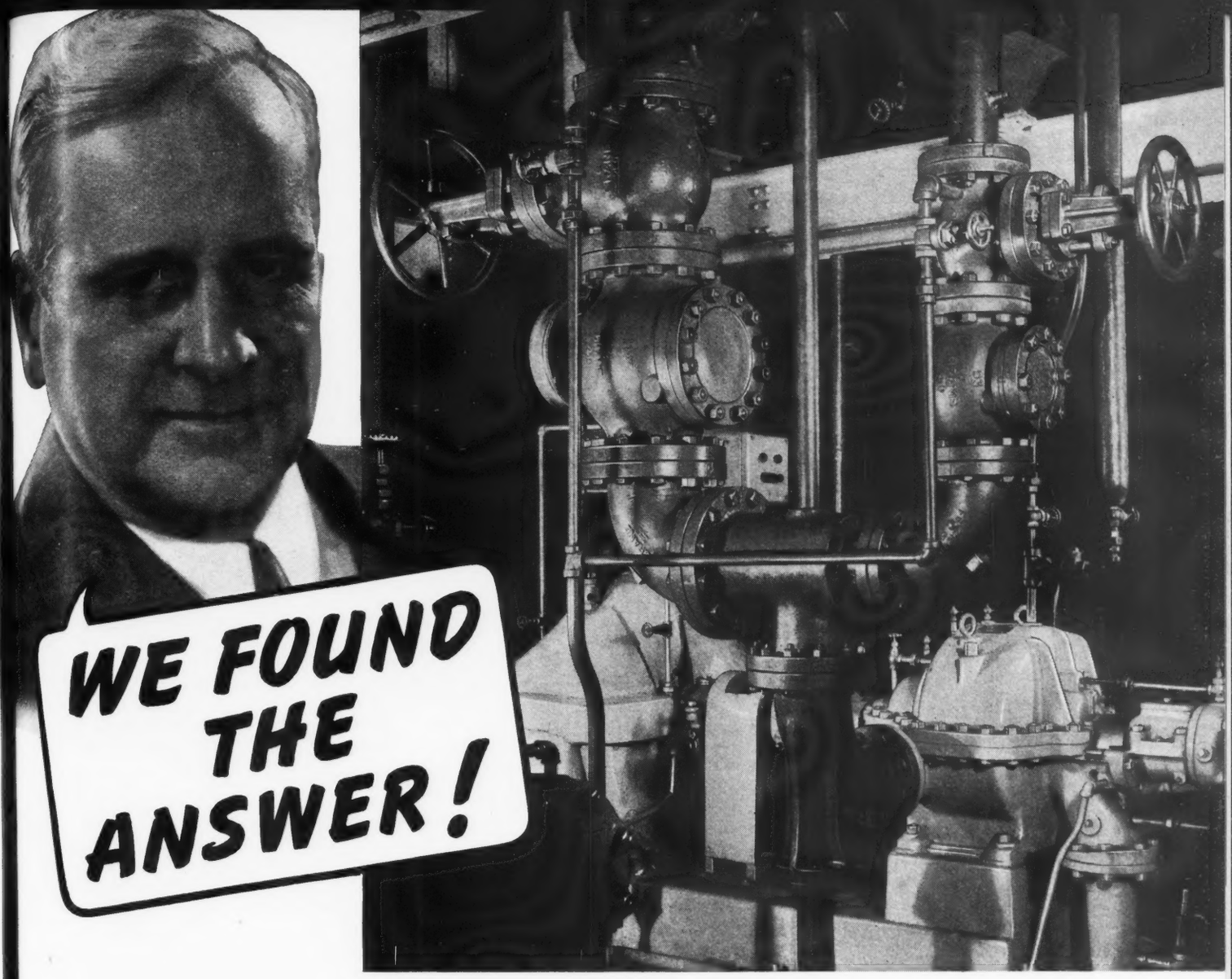
Right
BRAID-OVER-BRAID

STUDY the above photograph of Interlocked Braided Packing—notice how it differs from the ordinary types shown at the left. Made by a revolutionary new braiding process, exclusive with Johns-Manville, Interlocked has no layers or jackets to wear through—no plaits to flatten—all the long-fiber asbestos yarns are firmly and permanently interwoven—locked tightly together to form a solid integral structure that cannot ravel or come apart.

Furthermore, because Interlocked is braided square, not pressed into shape, it holds its form in service—presents a better packing face on the rod—provides a tighter seal.

For full details on this new type of braided packing, as well as detailed information on the complete line of J-M Packings and Gaskets, write for the J-M Packing Catalog. Address Johns-Manville, 22 East 40th Street, New York, N. Y.

JM JOHNS-MANVILLE
PACKINGS & GASKETS JUST PHONE YOUR NEAREST DISTRIBUTOR



"PREVENTIVE MAINTENANCE keeps our piping costs down"

ACTUALLY, it's nothing new—many hundreds of plants are doing it every day. It's just a matter of using good foresight when you're buying valves and fittings.

Preventive Maintenance is simply this: It means fortifying your piping with extra resistance to the stress and strain of service conditions. There lies your greatest assurance of dependable flow control at minimum cost. And it means making sure that your piping equipment is right for the job to be done—right for the safety required.

Whether your plant is small or large—with Crane valves and fittings you can carry on a successful program of Preventive Maintenance. That's because in Crane-Quality you get the finest development of design and materials in flow-control equipment. And in the Crane line of over 38,000 items is exactly the one you need for efficient and economical piping in every application in your system.

Just as he has helped others, your Crane Representative will gladly work with you. Through him, Crane's vast experience in solving industry's piping problems is applied to your individual case. Back of him, at your service, are Crane's extensive resources of technical knowledge, Crane's elaborate research and plant facilities.

If you *now* have a piping problem that's giving you headaches, then get started *now* on a Preventive Maintenance program. You'll save many dollars—you'll have peace of mind. Call your Crane Representative today.

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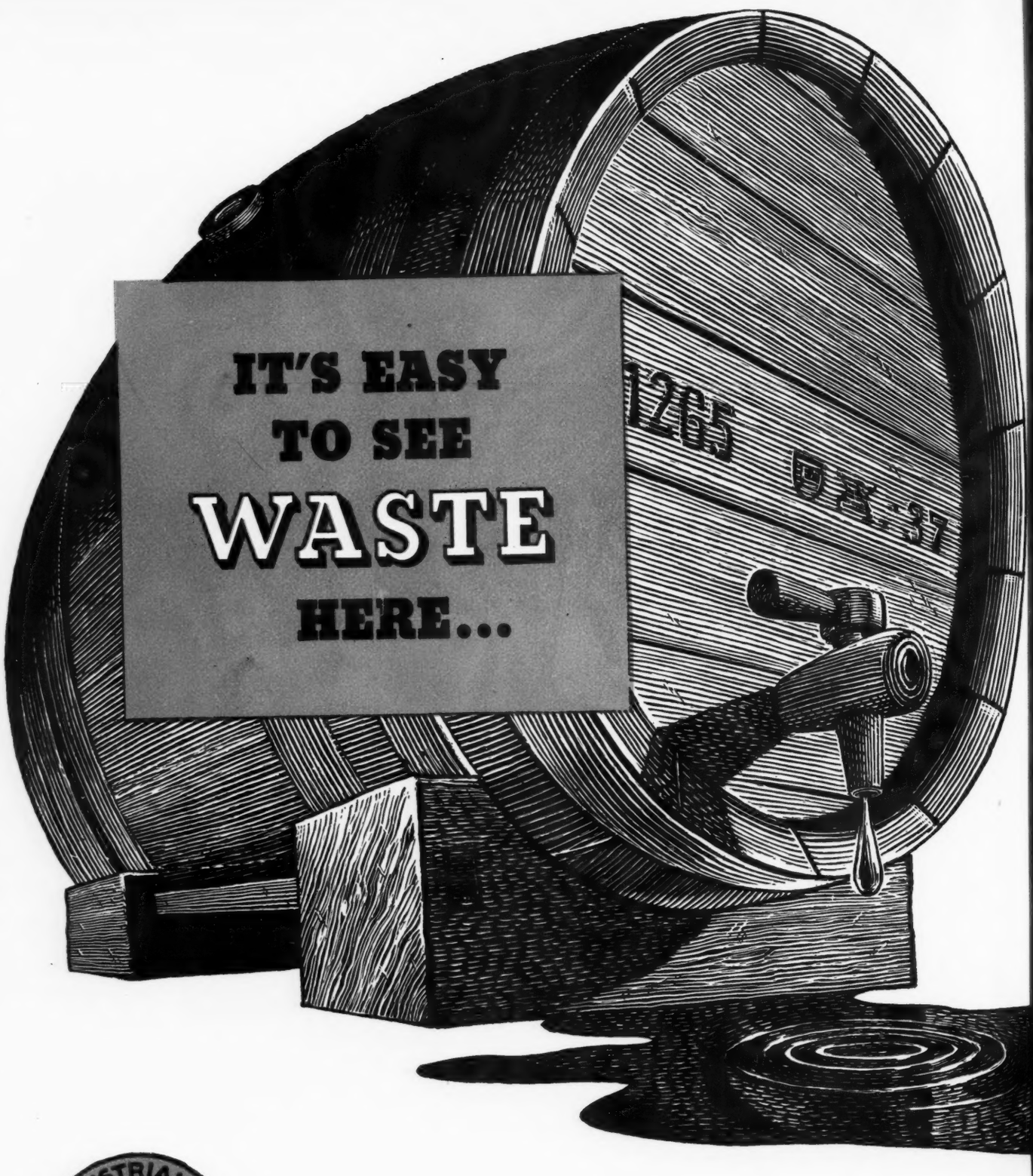

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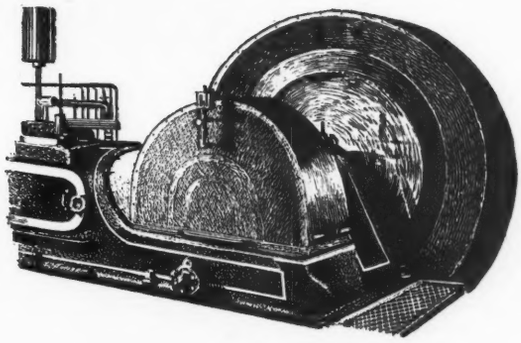
TIDE WATER

THERE IS A COMPLETE LINE OF TYCOL LUBRICANTS



. . . BUT CYLINDER OIL LOSSES OF OVER 33⅓% went unnoticed for years

Such a dollar-and-cents saving is news in itself. But the extra lubrication benefits obtained here are even bigger news.

To quote the superintendent: "Considerable trouble with our steam engine resulted because a large quantity of brown sludge was left in the lubricator by our cylinder oil. We changed to Tide Water E.A. Cylinder Oil. The trouble cleared up immediately and the Tide Water oil has been giving us an ideal lubrication job ever since. Besides giving us better lubrication with low consumption, Tide Water Cylinder Oil actually saves us 33⅓% in oil costs."

This modern Tide Water lubricant gives a good film of protection to cylinder walls. Like all Tide Water oils and greases, it gives greater lubrication at lower cost . . . assures efficient operation . . . fewer overhauls . . . lower maintenance costs.

A Tide Water engineer will gladly help you find and banish hidden wastes. He will recommend the TYCOL lubricant "engineered to fit the job."

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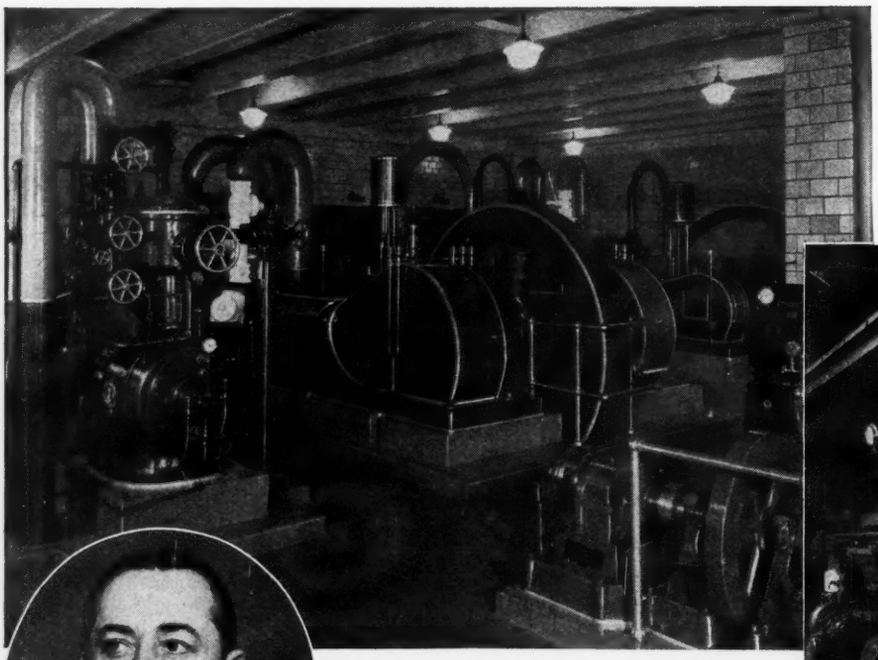
CYLINDER OIL

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE

"Substantial Reductions

IN OUR OPERATING COSTS"...

says
Chief Engineer
Samson



STEAM-DRIVEN AMMONIA COMPRESSORS in the plant of the Goebel Brewing Co., Detroit. *Switching* to Texaco Lubricants 4 years ago, Chief Engineer Samson has effected a 75% reduction in maintenance cost.

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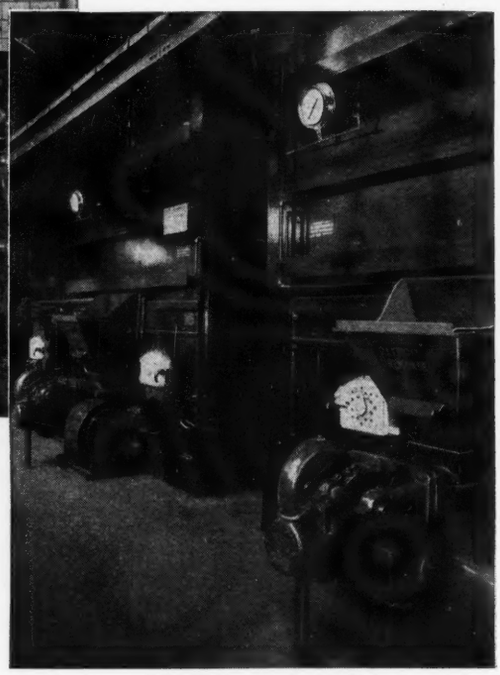
Left: **R. J. SAMSON,** Chief Engineer of Goebel Brewing Co. plant, reports that Texaco saves him lubrication worries, and enables him to show substantial reductions in operating costs. He recommends Texaco Lubricants and service.



MODERN BOILER ROOM of the Goebel Brewing Co., Detroit, presided over by Chief Engineer R. J. Samson, shown opposite. Aided by Texaco Lubricants and Texaco Engineering Service, Mr. Samson has shown a power saving of 8%. Naturally, he is enthusiastic for Texaco, based on the results he is getting.

IN 1935, the Goebel Brewing Company power plant in Detroit began to use Texaco Lubricants. Because of his success with them, Chief Engineer R. J. Samson says:

"Texaco saves me lubrication worries, and enables me to show my Company substantial reductions in operating costs. I recommend both Texaco and its service."

The Goebel plant is Texaco lubricated 100%. It uses Texaco steam cylinder oils in the steam ends of its compressors, Texaco Capella in the compressors, and Texaco Regal for gravity circulating external lubrication.

Engineers, trained in the selection and application of Texaco power plant lubricants, will gladly demonstrate savings with Texaco Perfected Lubrication.

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Texaco Dealers invite you to tune in The Texaco Star Theatre—a full hour of all-star entertainment—Every Wednesday Night — Columbia Network — 9:00 E.S.T., 8:00 C.S.T., 7:00 M.S.T., 6:00 P.S.T.

TEXACO Steam Cylinder Oils

How will this new world war affect the plants, loads, fuels and jobs of the power engineer?

Fuel prices have risen and will keep on rising. Both coal and oil will go up, but oil more than coal, we expect.

Coal-fired plants should check their fuel-burning "versatility"—their ability to shift to another variety of coal if price changes or shipping difficulties should make it necessary.

These three excerpts are from Mr. Swain's editorial "Fuels—Power—War" which appeared in the October issue of Power.

Is Your Plant PREPARED?

READING TIME 52 Seconds

● With Stowe Stokers in your plant you get practically unlimited "versatility"—They let you change from one bituminous or semi-bituminous coal to another almost without restriction of ash content, chemical analysis, or burning characteristics. In war time, with delayed shipments and possible interruptions in transportation, this "versatility" lets you burn practically any coal you can get. In peace times, it protects you against tie-ups resulting from strikes, mine fires, etc. And all the time—365 days a year—in war or peace—good times or depression—it gives you maximum control over your largest single item of expense—i.e., coal costs. Instead of depending on the coal produced by one mine or a relatively small number of mines as with "one-fuel stokers", Stowe Stokers burst the restrictions wide open. They let you buy over the entire range from 20% ash western coals to eastern Pocahontas coals, from whatever mine can make delivery to your plant at the lowest price per B.T.U. ton. Stowe Stokers give you maximum protection against price fluctuations . . . and unparalleled bargaining power in making coal purchases with resulting lower steam costs.

An ounce of precaution is worth a pound of regret. Send today for a fully illustrated catalog describing Stowe Stokers' accomplishments in "versatility—or better yet, take advantage of our offer to arrange inspection trips for power plant officials, and see for yourself, first hand, what Stowe Stokers have done and what they're doing.

STOWE STOKERS

THE JOHNSTON & JENNINGS CO. • CLEVELAND, OHIO

"We Wiped out Shutdowns that cost about $500.00 each by using BUSS *Super-Lag* FUSES"

H. N. DAVIS, *Purchasing Agent*
CENTRAL FORGING CO., CATAWISSA, PA.

"HERE'S OUR EXPERIENCE"

continues Mr. Davis. "We use specially designed forging machines for forming and punching our union forgings from steel bars. The heavy momentary overload on these forging machines formerly caused fuses to blow frequently. The die then had to be dismantled and the pieces of steel cut out of it.

"The loss in time and material we figured cost us about $500.00 —and the shutdowns were occurring so often that we even had a special cutter made at a cost of $300.00 to speed up cleaning out the die.

"Some time ago, at the suggestion of a salesman, we switched to BUSS Super-Lag Fuses. Since then we practically wiped out these costly shutdowns as the BUSS fuses have time-lag enough to hold the momentary overloads on our forging machines."

Here's Why BUSS *Super-Lag* FUSES Will Save Money For You, Too

Needless opening of fuses can generally be traced to one of two causes: a fuse-case design that permits the development of poor contact heating or a fuse-link design that doesn't give sufficient time-lag.

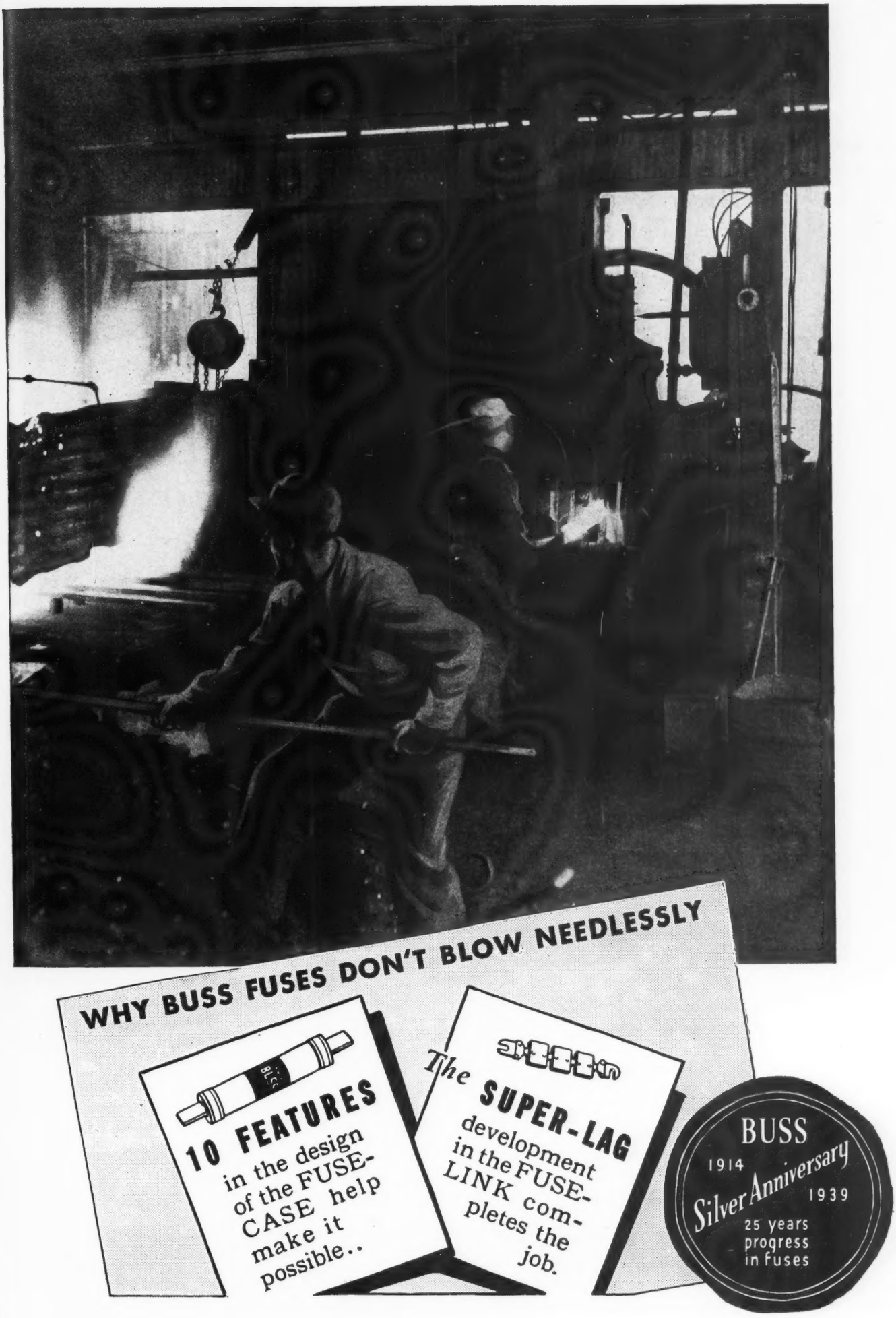
Years of engineering research and field and laboratory tests have produced in BUSS Super-Lag fuses a design that practically eliminates all needless opening from either of these causes.

Hence users of BUSS fuses enjoy a freedom from needless interruptions not possible with any other fuse.

Since this means a saving in time and money to your company, why not start today to specify BUSS Super-Lag fuses for all your fuse needs?

And if you would like to have a more complete picture of the details of BUSS construction so that you can show others just why BUSS fuses are suited to the particular needs of your plant, let us send you a copy of the RB book on fuses.

It shows, in quick reading style, how the design of the BUSS fuse can help you abolish senseless shutdowns in your plant. A line from you will bring a copy by return mail. BUSSMANN MFG. CO., University at Jefferson, St. Louis. Division of McGraw Electric Company.


WHY BUSS FUSES DON'T BLOW NEEDLESSLY
10 FEATURES
in the design of the FUSE-CASE help make it possible..
The SUPER-LAG
development in the FUSE-LINK completes the job.
BUSS
1914
Silver Anniversary
1939
25 years progress in Fuses

IT PAYS TO REGULATE "AIR TRAFFIC" in YOUR PLANT

"Proof of the Pudding" . . . In a Textile Plant

The Wade Manufacturing Company of Wadesboro, North Carolina, a large textile plant, recently installed a Gardner-Denver RX Compressor for a humidifying system. Compressor operates at 300 r.p.m. driven through V-belt drive by a 60 horsepower motor. Actual air delivery is 492 cu. ft. per min. at 35 lbs. pressure. The compressor is operating 8 hours a day for 5½ days a week and is frequently subject to double time. "We are perfectly satisfied," say the owners, "with its economical and dependable operation."

With this Money-Saving GARDNER-DENVER RX COMPRESSOR

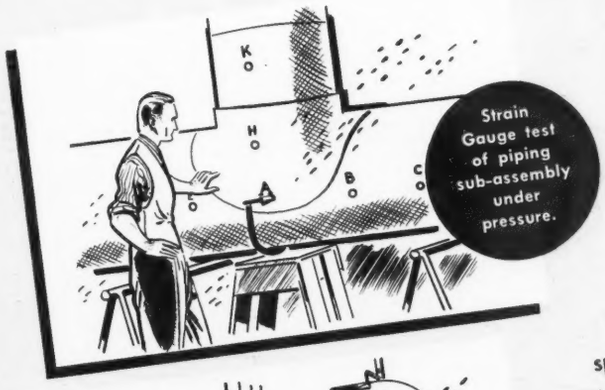
Regulate the "air traffic" in your plant —assure a smooth, unfailing flow of compressed air in exactly the right volume for your needs at any hour of the day . . . with a Gardner-Denver RX Air Compressor!

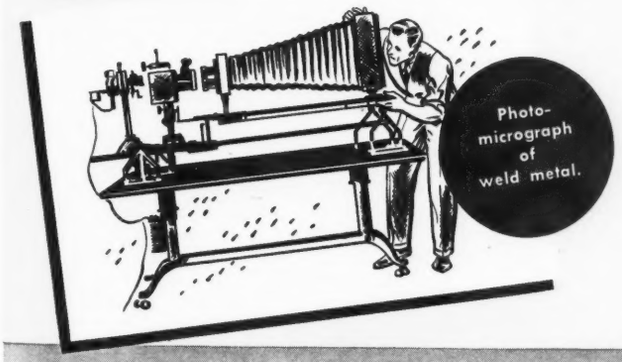
The Duomatic Control, which is unique and which may be had *ONLY* on Gardner-Denver compressors, automatically adjusts air supply to air needs. With this control, if the air requirements are above 50% of the compressor capacity, the compressor will run at constant speed with suction valve unloading. If the air demand falls below 50%, the control will automatically switch over to start and stop; thus the compressor will always operate in the most efficient manner regardless of the load and without requiring the attention of an operator.

In other ways, too, the RX Compressor stands as the guardian of your budget. Owing to its advanced design, it delivers a larger air volume with remarkably low horsepower per cubic foot of air delivered. And it has the *exceptional* dependability you need to keep air supply constant. Before you invest in any air compressor, find out all about Gardner-Denver RX Compressors. Write for Bulletin HAC-40. Gardner-Denver Co., Quincy, Illinois.

GARDNER-DENVER 80th ANNIVERSARY YEAR

PRESSURE PIPING





The Pipe Fabrication Institute sponsors continuous research into the many and varied ramifications of pressure piping. Such research by its members has developed the correct answers to many piping problems with resulting substantial savings to industry.

Behavior of pipe sub-assemblies under pressure . . . tensile tests of weld specimens . . . chemical analysis to determine possible chemical changes produced by welding . . . photo-micrograph inspection of weld sections . . . these and many other tests reveal much important data and act as a close control of welding and other fabrication procedure.

Qualified pipe fabricators apply information thus gained to provide the user with better and more economical piping.

RESEARCH

THE PIPE FABRICATION INSTITUTE

P.F.I. THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING PITTSBURGH, PA.

Repeatedly,
THE CHOICE-

ELECTRUNITE

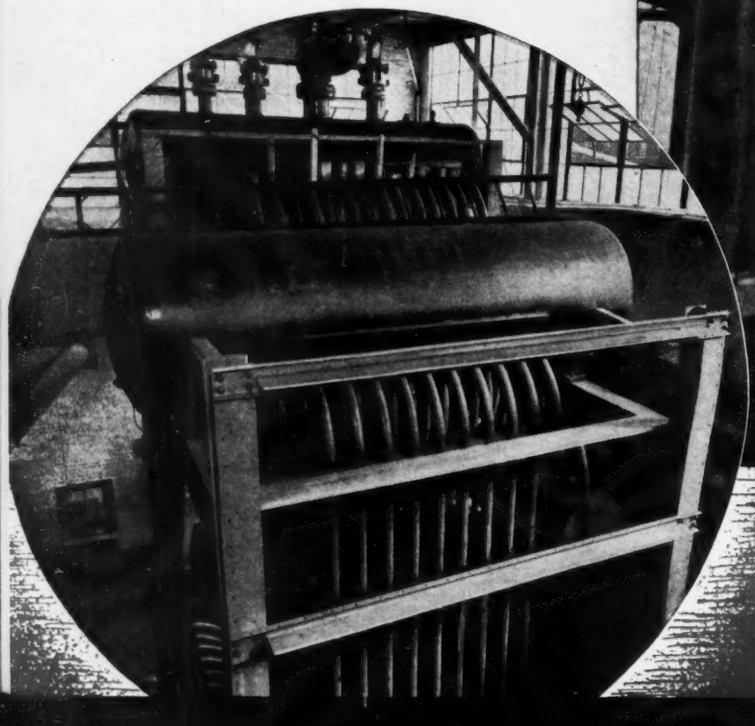
REG. U. S. PAT. OFF.

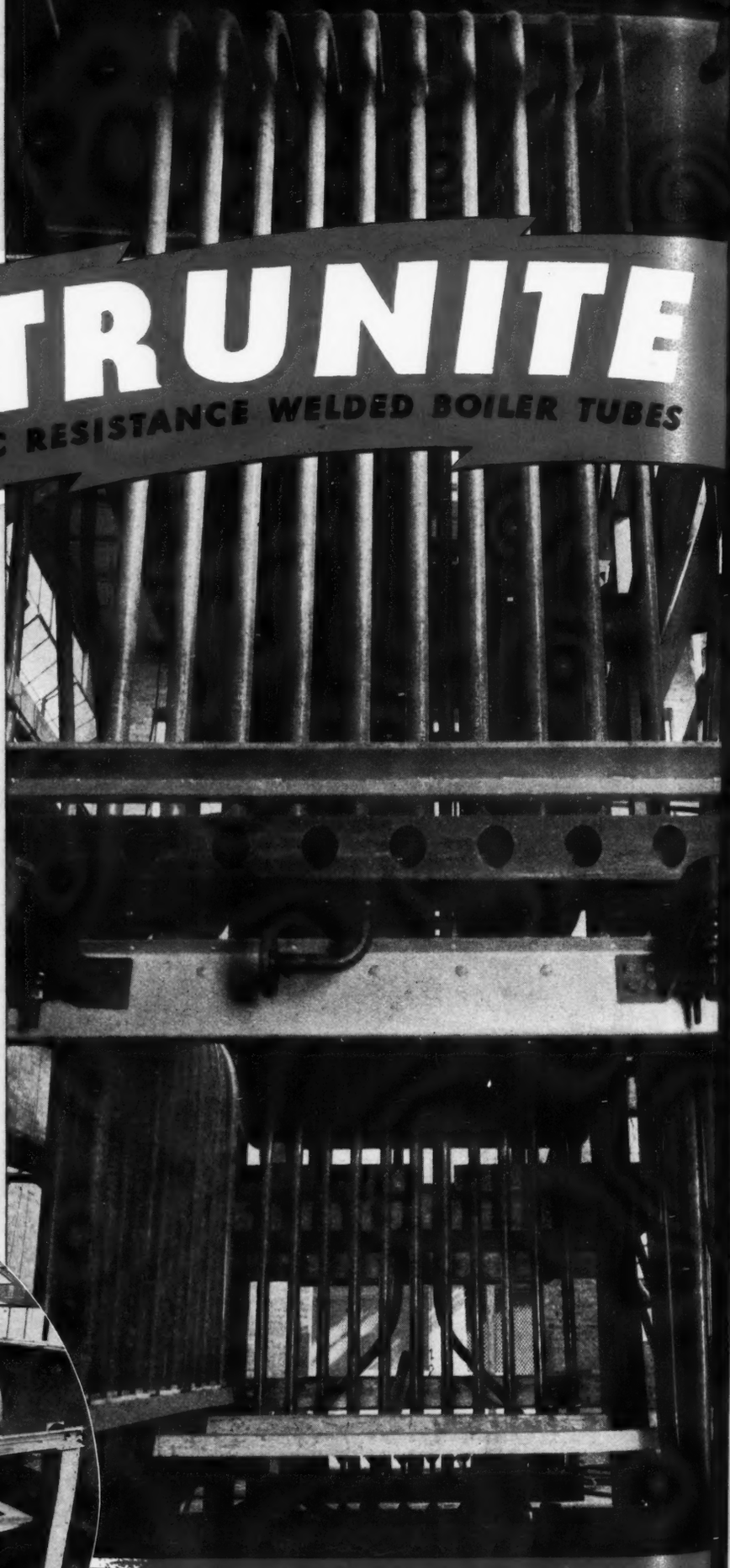
THE MODERN ELECTRIC RESISTANCE WELDED BOILER TUBES

When the Henry Vogt Machine Company built this 200 lbs. pressure, 300 h. p., four-drum bent tube boiler for A. Finkl and Sons Company, Chicago, Ill., they used ELECTRUNITE Boiler Tubes.

Time after time, boiler manufacturers and users choose ELECTRUNITE for new boilers and for retubing old ones. They have found that ELECTRUNITE Tubes, through their consistent uniformity, ductility, scale-free surface and freedom from hidden defects, reduce installation costs and insure safety and long, trouble-free service life.

Avail yourself of the advantages of these modern tubes to improve YOUR heat transfer equipment. Write us for the full story on what ELECTRUNITE can do for you.





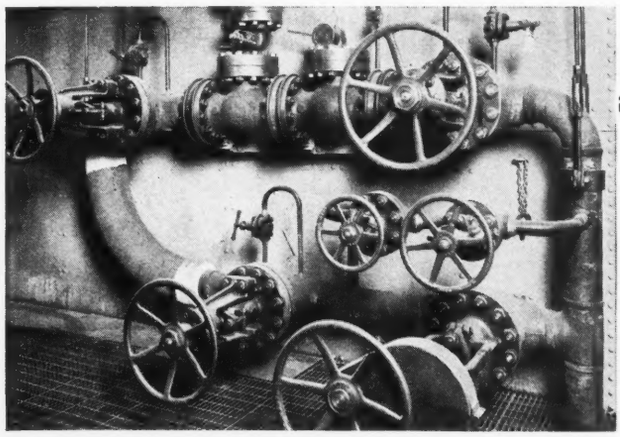
Steel and Tubes Division

REPUBLIC STEEL CORPORATION

CLEVELAND . . . . OHIO

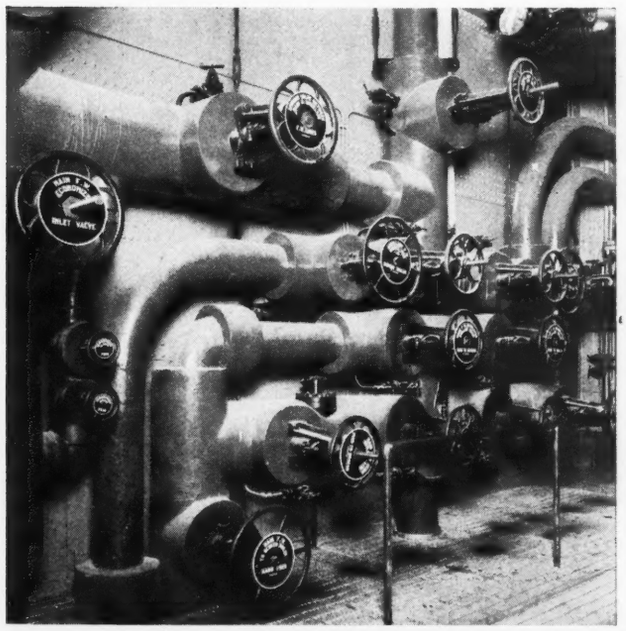
Modern Conditions Demand Feed Water Valves with

Haynes Stellite Alloy Seating Surfaces



Above: All of these valves on the three high-pressure boilers at Delray Station of The Detroit Edison Company have Haynes Stellite alloy seating surfaces.

Below: This shows the "valve nest" on the five low-pressure boilers at Delray Station. These valves also have Haynes Stellite alloy seating surfaces.



VALVES with Haynes Stellite alloy seating surfaces are being specified in modern power stations throughout the country for high-temperature, high-pressure steam and feed water service. Haynes Stellite alloy assures long, leak-proof service under severe operating conditions, because—

- this alloy is hard and abrasion-resistant even at red heat.
- it takes a high polish and has a low coefficient of friction.
- it resists scoring, galling, seizing, and wire-drawing.
- it will not corrode or pit.

Valves with Haynes Stellite alloy seating surfaces are now available from most valve manufacturers. Write for "Haynes Stellited Valves," an interesting booklet of performance records. Address the nearest Haynes Stellite office for a copy without obligation.

PRODUCT OF A UNIT OF UCC UNION CARBIDE AND CARBON CORPORATION

"Haynes Stellite" is a registered trade-mark of Haynes Stellite Company

HAYNES STELLITE TRADE MARK

Red-hard, wear-resisting alloy of cobalt, chromium and tungsten

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

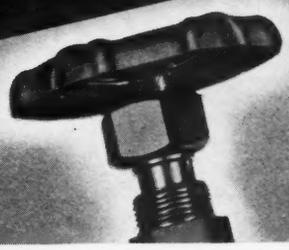
Chicago - Cleveland - Detroit - Houston - Los Angeles - New York - San Francisco - Tulsa

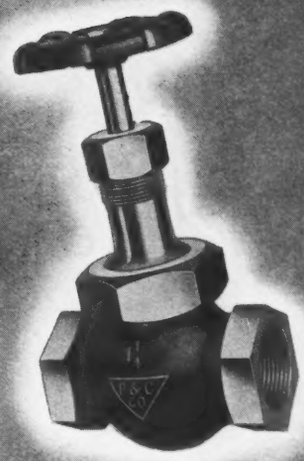
General Office and Works—Kokomo, Indiana
Foreign Sales Department—New York City

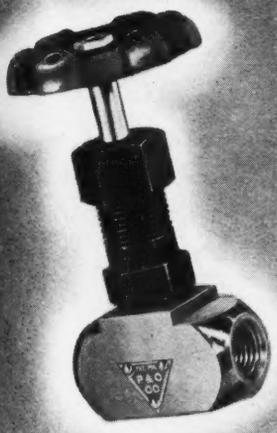
Haynes Stellite hard-facing rods and information on other Haynes Stellite Company products also are available through all apparatus shipping points of The Linde Air Products Company

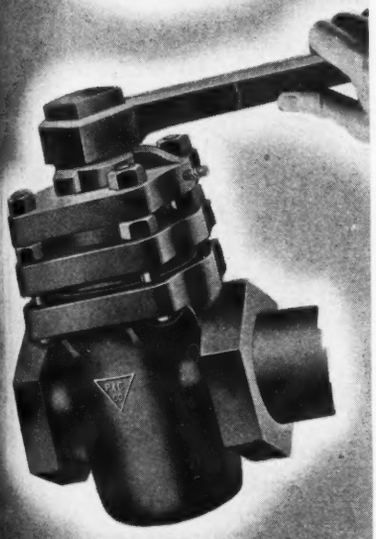
R
P&C
CO
Get READING-PRATT&CADY'S
RECOMMENDATIONS F
STEEL
STEEL

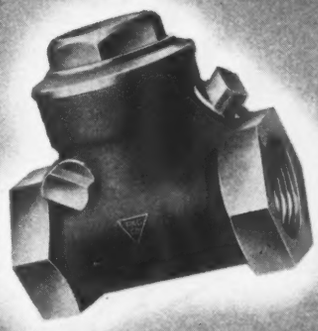
S FOR VALVES











●The valves on these pages tell a real story.

Below at the right is a Bronze Swing Check Valve, and above this a Bronze Globe Valve with "Slip-On" Discs—both original Pratt & Cady patents.

In the upper left of this page is a Bar Stock Valve, and below it an Asbestos Packed Cock—*also* introduced by Reading-Pratt & Cady.

The story told down through the years by these and other Reading-Pratt & Cady valves is one of most intimate and understanding co-operation of our organization with Engineers who work with steam—a story that reaches a climax with the modern Cast Steel, Motor-driven, Toggle-operated Globe Valve to handle temperatures to 950°F. and pressures to 1500 lbs.—shown in the upper left corner of the opposite page.

Doesn't this suggest that it would be good business, always, to write for our specifications? You can certainly depend on these more than 60 years of solid experience and forward thinking to give you recommendations pointed at low cost steam.

READING-PRATT & CADY

READING-PRATT & CADY DIVISION · BRIDGEPORT·CONNECTICUT

AMERICAN CHAIN & CABLE COMPANY, Inc.

AMERICAN CHAIN DIVISION • AMERICAN CABLE DIVISION • ANDREW C. CAMPBELL DIVISION • FORD CHAIN BLOCK DIVISION • HAZARD WIRE ROPE DIVISION • HIGHLAND IRON AND STEEL DIVISION • MANLEY MANUFACTURING DIVISION • OWEN SILENT SPRING COMPANY, INC. • PAGE STEEL AND WIRE DIVISION • READING-PRATT & CADY DIVISION • READING STEEL CASTING DIVISION • WRIGHT MANUFACTURING DIVISION • IN CANADA: DOMINION CHAIN COMPANY, LTD. • IN ENGLAND: BRITISH WIRE PRODUCTS, LTD. • THE PARSONS CHAIN COMPANY, LTD. • *In Business for Your Safety*

The Equalized Ply Stresses in . . .

Condor Compensated Belts

PATENTED

TRADE MARK REGISTERED

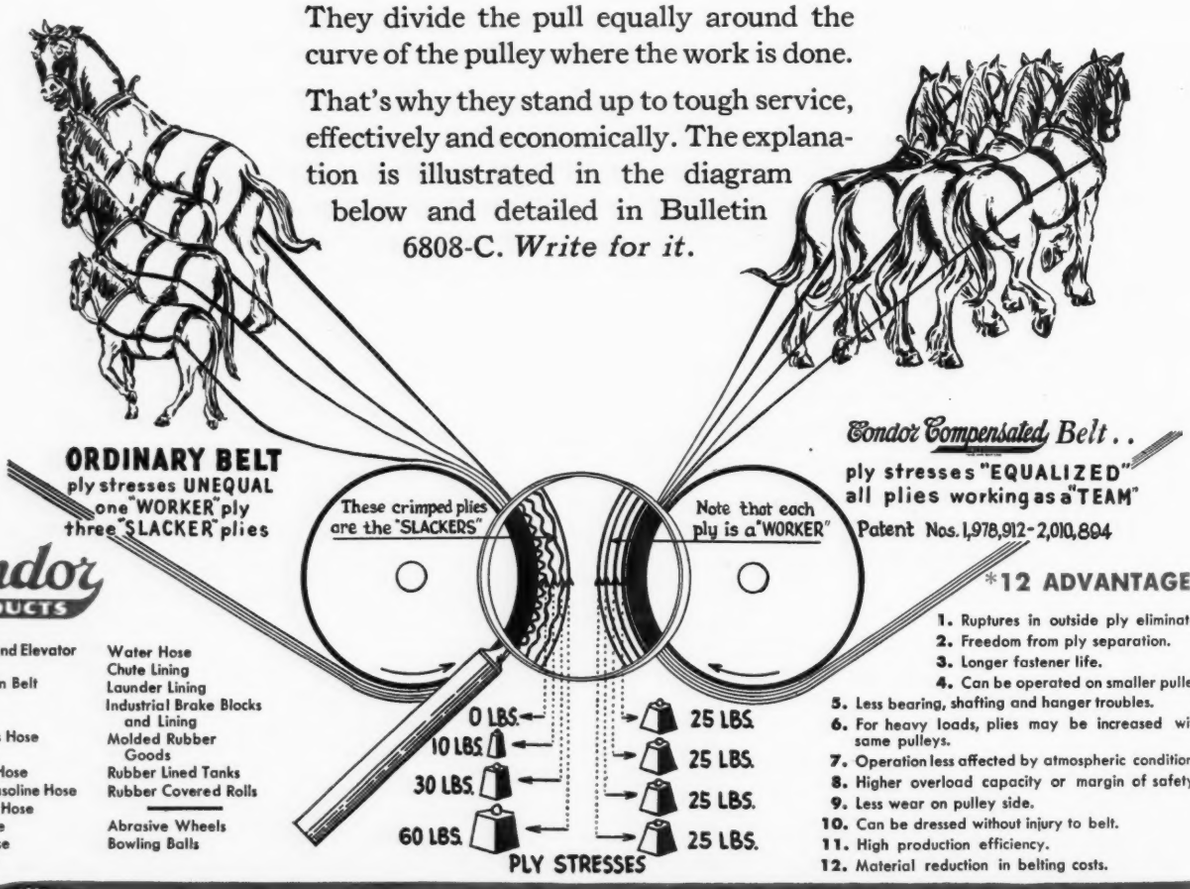
Make a Matched Team for Horsepower

THEY'RE gait-matched and strength-matched; they pull together equally, regardless of whether the load is heavy or light and regardless of whether the pulleys have large or small diameter.

There are no power ponies hitched up with power horses when you have equalized ply stresses.

They divide the pull equally around the curve of the pulley where the work is done.

That's why they stand up to tough service, effectively and economically. The explanation is illustrated in the diagram below and detailed in Bulletin 6808-C. *Write for it.*



Condor PRODUCTS

- Conveyor and Elevator Belt
- Transmission Belt
- V-Belt
- Air Hose
- Contractors Hose
- Fire Hose
- Hydraulic Hose
- Oil and Gasoline Hose
- Sand Blast Hose
- Steam Hose
- Suction Hose
- Water Hose
- Chute Lining
- Launder Lining
- Industrial Brake Blocks and Lining
- Molded Rubber Goods
- Rubber Lined Tanks
- Rubber Covered Rolls

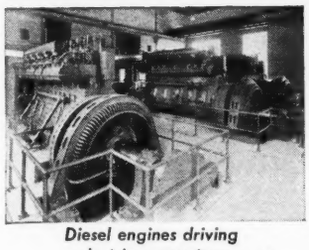
- Abrasive Wheels
- Bowling Balls

***12 ADVANTAGES**

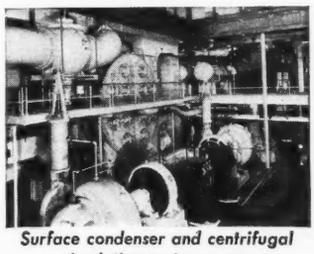
1. Ruptures in outside ply eliminated.
2. Freedom from ply separation.
3. Longer fastener life.
4. Can be operated on smaller pulleys.
5. Less bearing, shafting and hanger troubles.
6. For heavy loads, plies may be increased with same pulleys.
7. Operation less affected by atmospheric conditions.
8. Higher overload capacity or margin of safety.
9. Less wear on pulley side.
10. Can be dressed without injury to belt.
11. High production efficiency.
12. Material reduction in belting costs.

THE MANHATTAN RUBBER MFG. DIVISION
OF RAYBESTOS-MANHATTAN, INC.
EXECUTIVE OFFICES AND FACTORIES
31 Townsend St., Passaic, N. J.

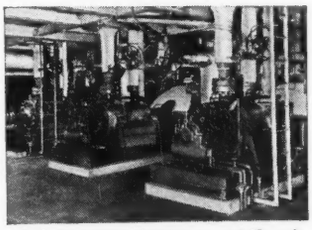
WORTHINGTON EQUIPMENT
for the POWER PLANT



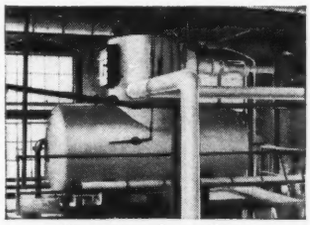
Diesel engines driving electric generators



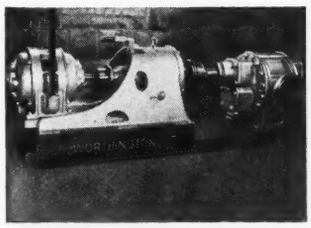
Surface condenser and centrifugal circulating water pumps



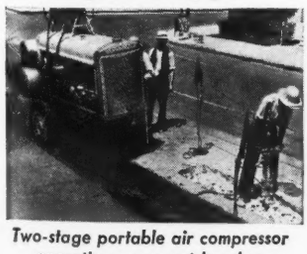
High pressure, six-stage centrifugal boiler feed pumps



Open type deaerating feedwater heater



Motor-driven rotary pump with speed reducing gears



Two-stage portable air compressor operating pavement breaker

DIESEL ENGINES
Vertical 4-cycle direct-injection and air-injection types.

GAS ENGINES
Horizontal 4-cycle double- and vertical 4-cycle single-acting.

CONVERTIBLE GAS-DIESEL ENGINES
Vertical 4-cycle, readily and quickly convertible for operation on either gas or fuel oil.

STEAM TURBINES
All types for generator and equipment drives.

SPEED CHANGE GEARS
Reducing and increasing.

STEAM CONDENSERS
Surface, barometric and jet types, for all ranges of capacity. Complete systems with auxiliary pumps, ejectors, etc.

STEAM-JET EJECTORS (For vacuum service)
One-stage to four-stage, with pre-condensers, inter-condensers and after-condensers.

VACUUM PUMPS
Rotative Dry Type—Horizontal and vertical; single-stage and two-stage. Electric or steam drive.
Direct-Acting Wet Type—Horizontal single-stage.

FEEDWATER HEATERS
Deaerating and non-deaerating, open type.

AIR AND GAS COMPRESSORS
Stationary—Horizontal, vertical and angle types, single-stage and multi-stage. All types and sizes. Electric, steam, Diesel engine or gas engine drive.
Portable—Two-stage, air-cooled, all types of mountings. Gasoline, Diesel or electric motor drive.

AIR CONDITIONING AND REFRIGERATING EQUIPMENT
Condensers, Coolers, Heat Exchangers, Freezing Equipment, Absorption Equipment, Steam-Jet Vacuum Cooling Equipment.

V-BELT DRIVES—(Multi-V-Drive)
V-grooved sheaves; Goodyear belts; complete drives; belts only.

CENTRIFUGAL PUMPS—HIGH PRESSURE MULTI-STAGE AND GENERAL SERVICE
For boiler feed, pressure applications, circulating, other general services.

TURBINE WELL PUMPS
For water supply, drainage, sump and other applications.

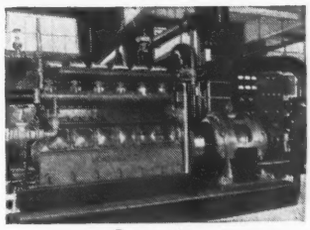
STEAM PUMPS
Simplex and duplex direct-acting pumps for boiler feed and general service.

POWER PUMPS
For boiler feed, pressure applications and general service.

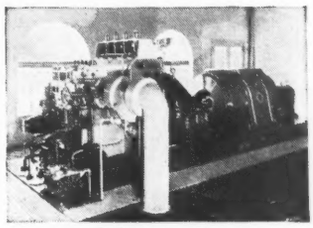
ROTARY PUMPS
Positive displacement, for transfer of non-abrasive liquids.

LIQUID METERS
For hot or cold water. Disc, turbine, compound and piston types.

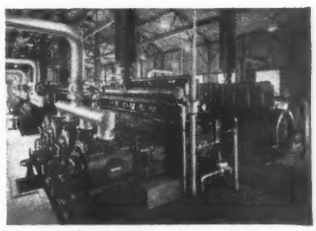
CONSTRUCTION AIR TOOLS
Clay diggers, trench diggers, tampers, pavement breakers, etc.



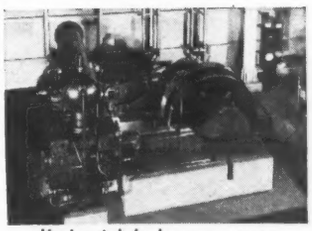
Gas engine driving generator



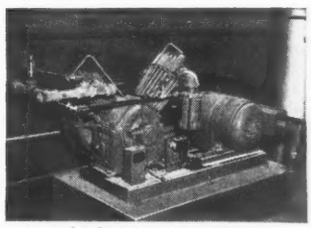
Turbo-generator unit



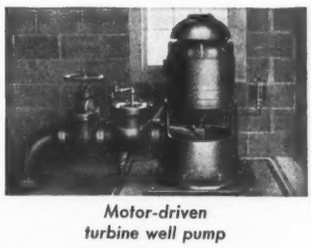
Angle type gas engine compressors



Horizontal duplex compressor for large air requirements



Angle type compressor for medium air supply

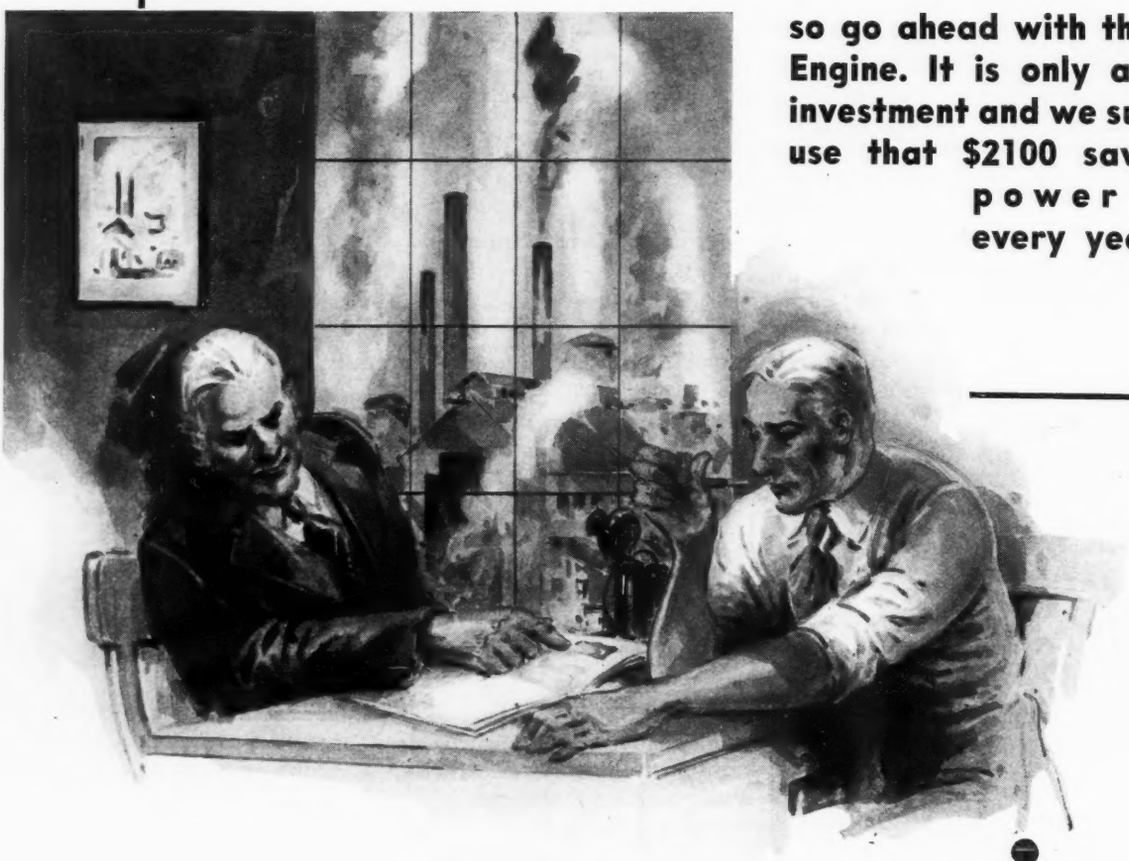


Motor-driven turbine well pump

WORTHINGTON PUMP AND MACHINERY CORPORATION
General Offices: **HARRISON, NEW JERSEY** • *Offices and Representatives in Principal Cities*

IC9-22

"Your cost estimate looks okay, Bill,



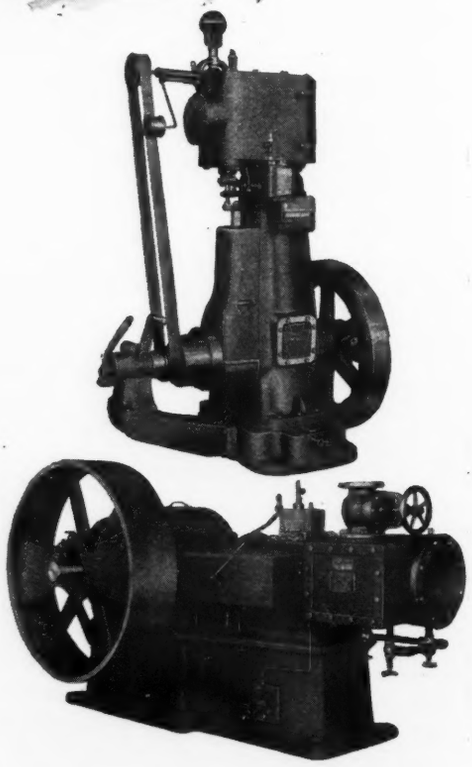
so go ahead with the Troy Engine. It is only a $1500 investment and we sure can use that $2100 saving in power cost every year."

Conversations along just these lines have been taking place recently in many a plant. Troy-Engberg Steam Engines are being ordered for driving stokers, pumps, compressors, fans, and other types of auxiliary equipment. And no matter what they will drive, the savings will be substantial.

Low power cost comes about through a low and sustained steam rate; through high retention of the thermal units for processing or heating; through low oil consumption; and through almost complete absence of repairs during many years of operation.

We can show plenty of cases where savings range upwards from $1,000 a year after plants shifted over to a Troy-Engberg drive. What we suggest is that you investigate this drive for every piece of equipment in your plant. And don't overlook the fact that the engine has many desirable mechanical features, too.

In writing for recommendations, give as much information concerning your steam conditions as you can.



TROY ENGINE AND MACHINE CO.

Established 1870

1455 Railroad Ave. **Troy, Pa.**

TROY-ENGBERG

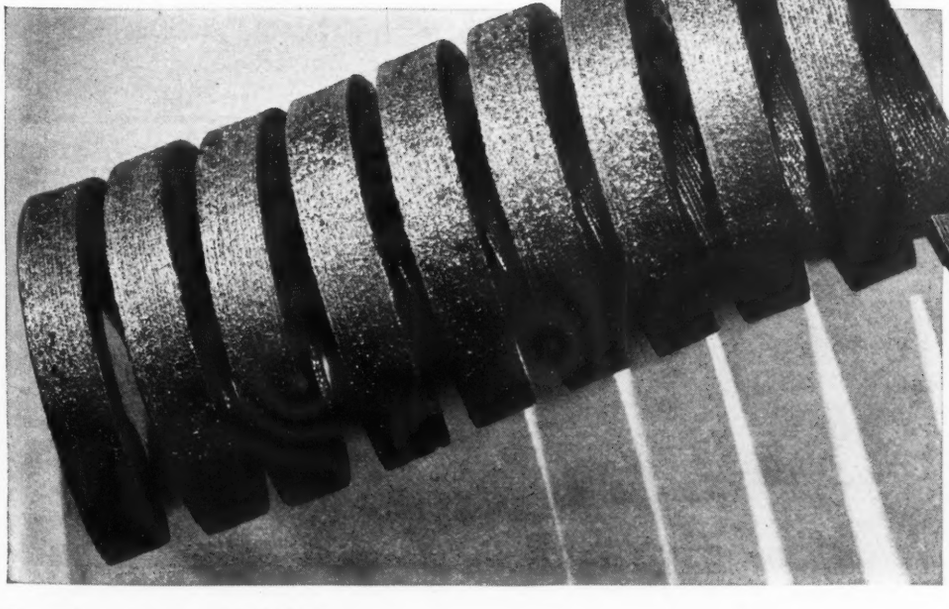
Star!

AS much of a star in its field as the high scoring basketball player is in his, GARLOCK 777 Rubber and Duck Spiral Packing gives outstanding service against hot or cold water and low pressure steam. If formed rings are desired specify GARLOCK 333.

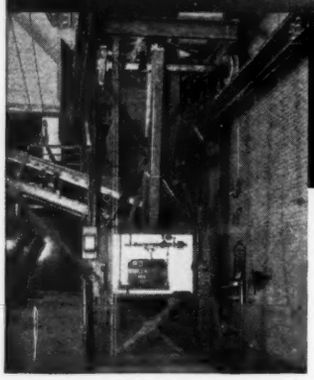
THE GARLOCK PACKING CO., PALMYRA, N. Y.

In Canada: The Garlock Packing Co. of Canada Ltd., Montreal, Que.

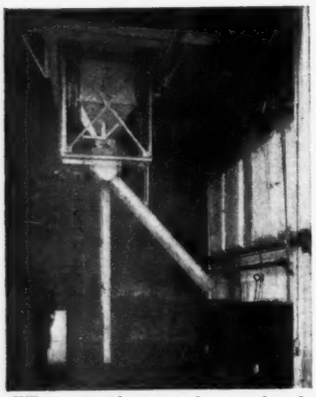
GARLOCK 777



power figures start at the weigh larry...



Note the uphill conveyor feed made necessary by the low headroom under the deeper storage bins.



Where gravity can be employed intelligently it further reduces handling costs and saves space.

The case history of every boiler . . . a record of the amount of coal consumed each day, compared with the power generated . . . is necessary to determine, accurately, the quality of the fuel and the efficiency of the various plant units. With a well designed Weigh Larry, the basic data are produced as an unpaid-for by-product while reducing the cost of handling coal to the stokers. Robins has developed Weigh Larry design to a high degree. Limits of headroom, area available, location of hoppers and a host of other difficulties have been met and overcome by Robins engineers. If you still handle coal without a Weigh Larry it is worth your while to discuss the matter with a Robins representative.

A Robins representative will gladly study the arrangement of your plant and suggest and quote you on coal and ash handling equipment that will save you money.

ROBINS MAKES

BELT CONVEYORS
PIVOTED BUCKET CONVEYORS
CRUSHERS FEEDERS
WEIGH LARRIES
SKIP HOISTS GATES

MATERIAL HANDLING ROBINS EQUIPMENT

Robins Conveying Belt Co., 15 Park Row, New York

I would like as indicated: Representative to call ( );

Information about ( ); Bulletin on .....

Name .....

Firm .....

Address .....

City ..... *State* .....

A RAMPAGING RIVER

SWIRLED OVER THESE SOLVENT RECOVERY STILLS ...WITHOUT HARMING THEIR K & M INSULATION

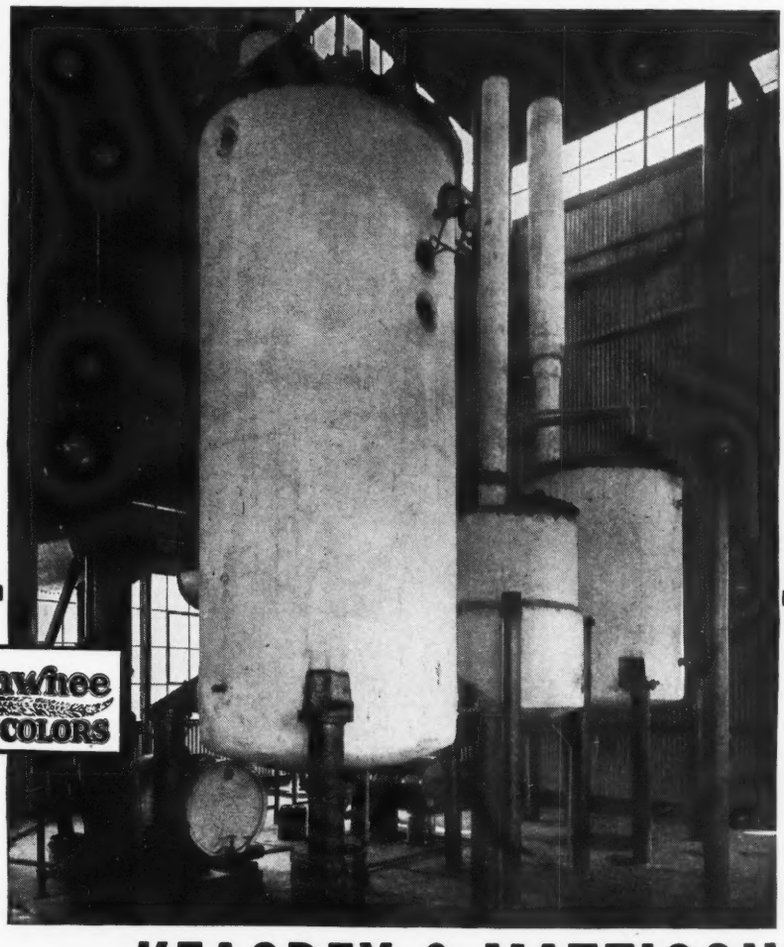
The insulated lacquer solvent recovery stills in the Kentucky Color and Chemical Company's plant at Louisville are veterans of the Ohio River flood. Hour after hour, the prying, muddy fingers of the water pressed and probed into the Keasbey & Mattison insulation with which the stills are encased.

When the river went down, the engineer of the plant went back expecting to find the insulation changed to a worthless, soggy pulp. It was dirty . . . but nothing more. Washed clean, dried, and repainted, it proved as efficient as ever.

The insulation was supplied and installed by the Louisville Insulating and Roofing Company, who say: "To protect our reputation for good service as insulation experts we demand the highest quality in the insulation products we handle. That is why we use K & M. Once installed in a customer's plant, K & M insulations are their own best salesmen."

K & M

ASBESTOS AND MAGNESIA PRODUCTS



Keasbey & Mattison materials are the products of specialists. The Keasbey & Mattison Company has pioneered since 1873 in the development of superior Asbestos and Magnesia products that save heat, fuel and money for plants in every industry. K & M engineers, working with K & M Distributors strategically located throughout the country, can point the way to real savings in your plant, too. Why not write Dept. 11 for further details?

Shawnee DRY COLORS

KEASBEY & MATTISON

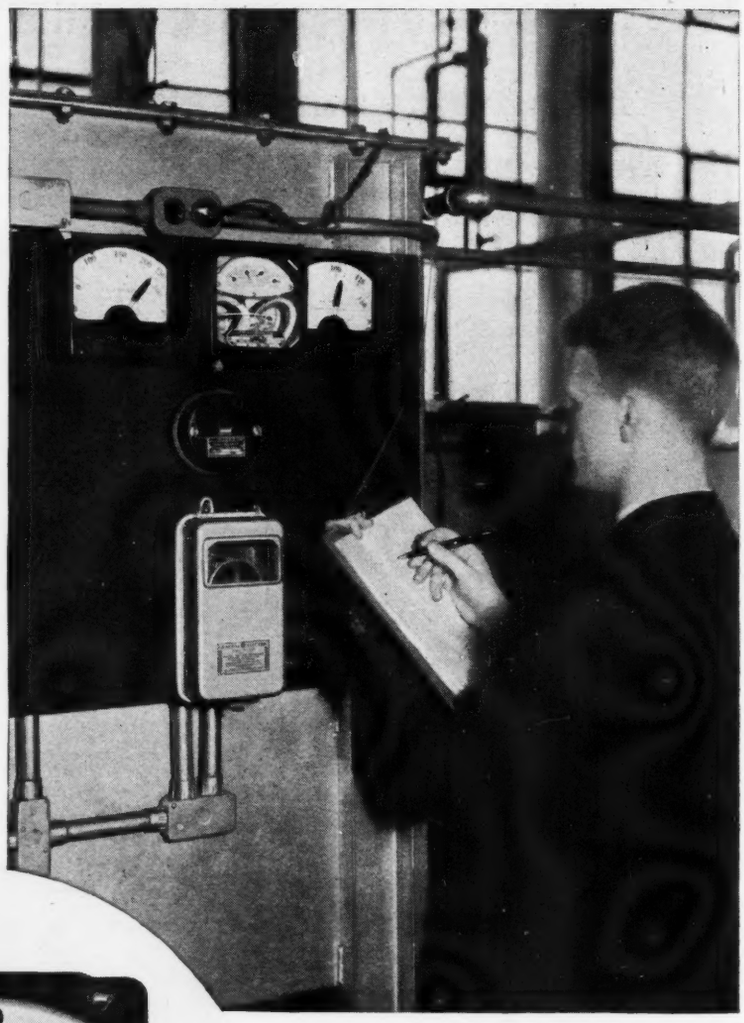
COMPANY, AMBLER, PENNSYLVANIA

See How Easy It Is to Get the Facts--
With G-E INSTRUMENTS

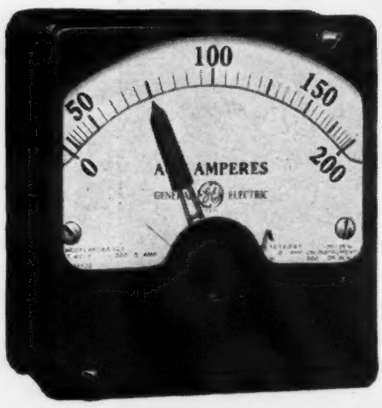
AND you don't necessarily need a switchboard full of them, either—sometimes a single Type AD-6 voltmeter, or one of the new G-E inkless recorders, will give you all the information you need to save on operating costs and to boost production. Sometimes two or three instruments will prove adequate and be a profitable investment.

For example, here's an instrument set-up on a box-type furnace: a Type AD-6 voltmeter and ammeter, both used in resistance measurements; a watthour meter to measure radiation losses. Yet with even such a simple arrangement, the operator knows at a glance *important* facts of operation. (A time meter counts the hours the furnace has operated, and a time switch turns the power on automatically.)

Perhaps one pocket-size portable will take care of your measuring needs—help you promote efficient operation, maintain product uniformity, prevent expensive shutdowns. But whether you need one instrument or dozens, you will find a G-E instrument for your particular job. For further information, call the nearest G-E office.



HEADQUARTERS FOR ELECTRICAL MEASUREMENT



← **TYPE AD-6**
Rectangular Switchboard Instrument

Ammeters, voltmeters, wattmeters, power-factor meters and special instruments—with antiglare glass, antiparallax scale, magnetic damping, high torque, excellent accuracy. Available for surface or semi-flush mounting and also for d-c service. Write for Bulletin 1758-B. General Electric Company, Schenectady, New York.

GENERAL ELECTRIC

430-161

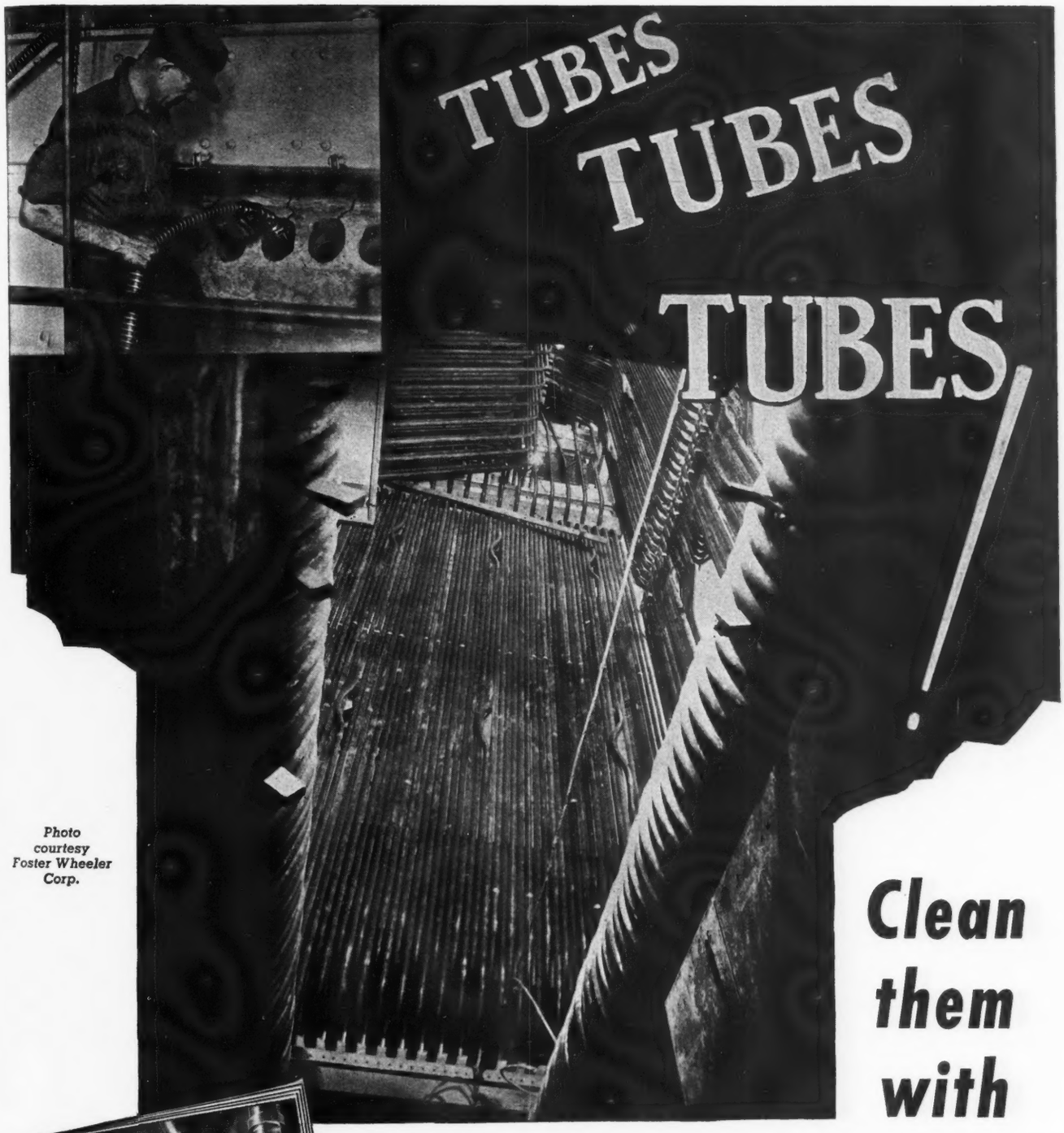


Photo courtesy Foster Wheeler Corp.

Y-149

Clean them with

LAGONDA and LIBERTY

TUBE CLEANERS

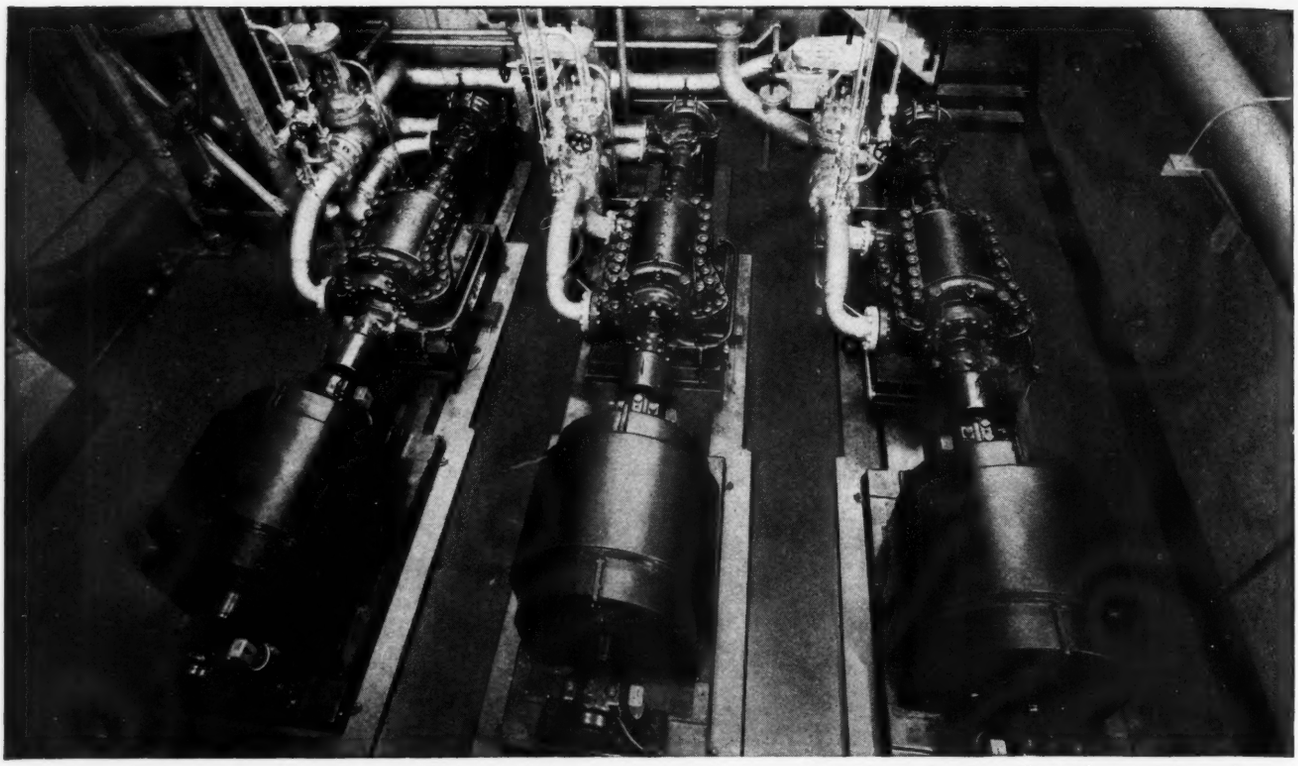
Available in many combinations of motor and cutting heads for cleaning all types and sizes of tubes, straight or curved — removing all kinds of deposit. Forty years of experience back of Lagonda and Liberty cleaners. Bulletin Y-6 gives some vital tube cleaning facts. Write.

ELLIOTT COMPANY

LAGONDA-LIBERTY *Tube Cleaner Dept.*

SPRINGFIELD, OHIO

District Offices in Principal Cities



● Three De Laval pumping units supplying descaling spray nozzles on a 98 inch steel strip mill, each consisting of a seven-stage single suction pump in series with a two-stage imposed impeller pump; capacities 1200 g.p.m. each against 1200 lb. net pressure at 1750 r.p.m.

DE LAVAL *Multistage* PUMPS

have perfect axial balance

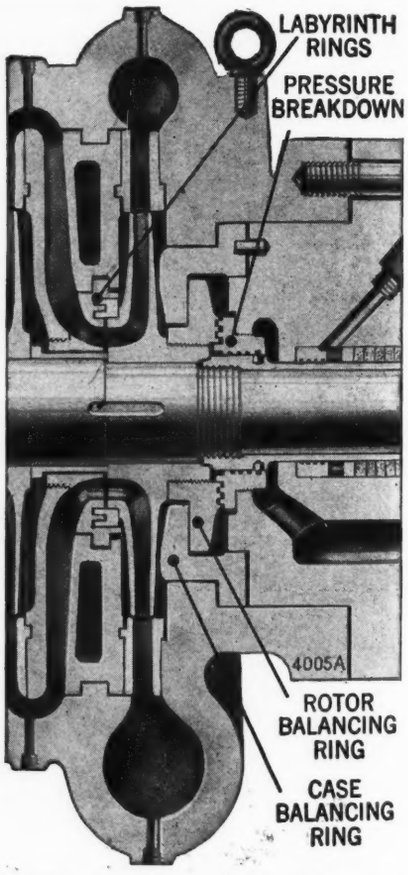
No thrust bearing is needed

THE De Laval automatic hydraulic balancing arrangement for multistage pumps eliminates end thrust entirely.

The pump is always in perfect axial balance under any operating condition. The balancing disks do not come into contact and wear of these disks will not affect the automatic balancing action nor decrease the efficiency of the pump, since the rotor will always adjust itself axially to create in the balancing chamber the pressure required to offset all end thrust caused by normal or abnormal operating conditions.

No thrust bearing is necessary. De Laval multistage pumps without thrust bearings have been in continuous satisfactory operation for over 20 years. In one pump which has operated at 1600 lb. pressure for more than 40,000 hours, the original balancing disks and bleed-off bushings are still in use and have not worn sufficiently to affect the efficiency measurably.

A full discussion of various balancing arrangements is given in our new Catalog B-5 on Multistage Pumps; sent upon request.



● Sectional view showing last stage impeller and automatic axial balancing device.

3208

DE LAVAL STEAM TURBINE CO. . . TRENTON, N.J.